



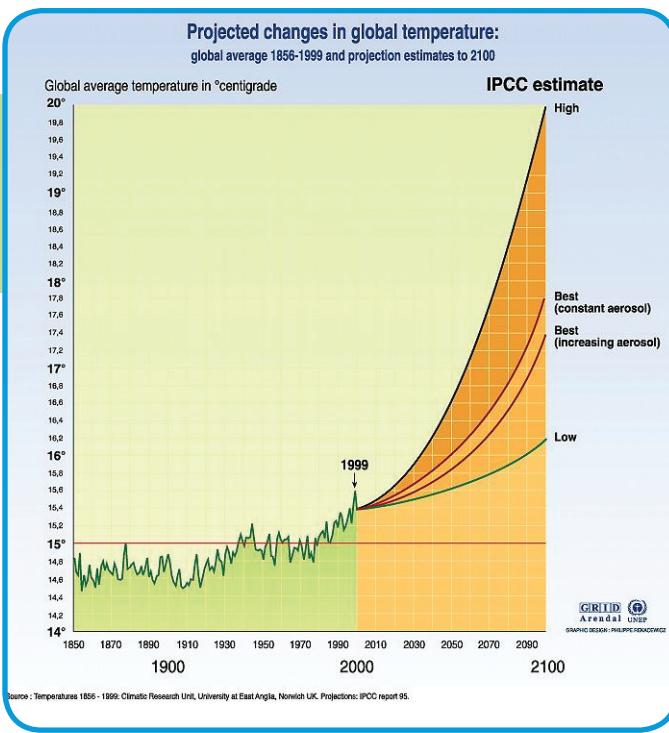
City of Roseville Greenhouse Gas Emissions Reduction Action Plan Analysis

Final Report
August 2009



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Acknowledgements

There were many individual contributors to the success of this project. The City of Roseville Staff provided the key information required to develop the measures in these Action Plans. The Roseville Green Team, Julia Burrows and Terri Shirhall in particular, provided consistent support and clear guidance throughout the project. The support of Roseville City Manager Craig Robinson has ensured the active support of this project by the entire Roseville team. The depth of this analysis and breadth of the reporting is a result of the quality and volume of information brought forward by these specialists. The work of KEMA, represented in their Greenhouse Gas inventory for the City of Roseville, has been a valuable resource for this work, as have the many engineering reports and proposals completed by engineering firms and integrated into these findings. Finally, ultimate appreciation goes to the Roseville City Council for their vision for a stronger, more secure future for the Roseville community, expressed in many ways, including their support for this important work.

Disclaimer: Tellus Applied Sciences does not imply any guarantees. The information contained in this report is intended to support the City in its efforts to understand the greenhouse gas emissions trend and opportunities for City operations and employee commutes. All results are approximations using standard engineering methodologies, based on best available information and historical energy usage.



Definition of Terms

CEC (California Energy Commission) The CEC is California's primary energy policy agency. They are responsible for forecasting future energy needs, promoting energy efficiency through appliance and building standards, and supporting renewable energy technologies.

CNG (Compressed Natural Gas) Compressed Natural Gas is a substitute to gasoline, diesel, or propane fuel. It is made by compressed natural gas, mainly methane (CH₄).

CO₂e (Equivalent Carbon Dioxide) Equivalent Carbon Dioxide is the concentration of carbon dioxide that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas such as methane, perfluorocarbons, and nitrous oxide.

GHG (Greenhouse Gas) Greenhouse gases are the gases in the atmosphere, which reduce the loss of heat into space and therefore increase global temperatures. Greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons.

ICLEI (International Council for Local Environmental Initiatives) ICLEI was formed in 1990 and is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development.

IRR (Internal Rate of Return) Internal Rate of Return is a budgeting metric used to decide whether to make an investment or not. It is an indicator of the efficiency of an investment. A larger IRR is a stronger investment.

kWh (kilowatt-hour) A kilowatt-hour is used to express amounts of energy delivered by electric utilities. One watt hour is the amount of energy expended by a one-watt load drawing power for one hour.

Metric Ton A metric ton equals 2,205 lbs. A short ton equals 2000 lbs.

Net Capital Cost The net capital cost is the capital cost of a project minus incentives and rebates.

NPV (Net Present Value) Net present value is a standard method for the financial appraisal of long-term projects. It measures the excess or shortfalls of cash flows, in present value terms, once financing charges are met. NPV indicated how much value an investment or project adds to the value of the business or firm.

O&M (Operations and Maintenance) Operations and maintenance refers to the maintenance and fuel cost incurred by a unit of equipment. The O&M costs in this analysis are the additional operation costs associated with the efficiency measure.

PV (Photovoltaic) Photovoltaic cells convert light energy into electricity. Also called solar power.

RPC (Renewable Portfolio Standard) Established in 2002 under Senate Bill 1078 and accelerated in 2006 under Senate Bill 107, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country. The RPS program requires electric corporations to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually, until they reach 20% by 2010.¹

¹ California Public Utilities Commission, <http://www.cpuc.ca.gov/PUC/energy/Renewables/>

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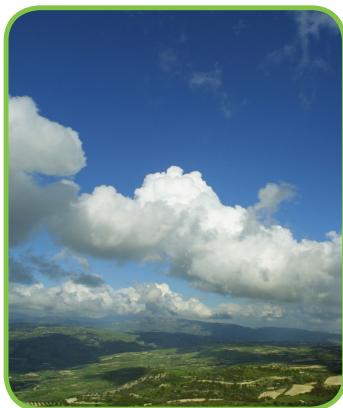


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1.0 Executive Summary

The City of Roseville is a full service community, located in Placer County along the eastern edge of the Sacramento Valley, at the base of the Sierra Nevada foothills. The city is 16 miles from Sacramento, the state capital. Roseville's climate ranges from hot, dry summers to mild winters. It was incorporated on April 10, 1909 and had an estimated population of 104,655 residents on January 1, 2006.¹ Roseville has pursued numerous projects promoting environmental stewardship; including the Roseville Utility Exploration Center, photovoltaic projects, regional polystyrene (Styrofoam) recycling, and a broad range of facility energy efficiency projects. The city has extended its tradition of stewardship by embracing the ICLEI program to reduce the greenhouse gas (GHG) emissions from city controlled sources.² The goal to address community wide emissions will extend this effort, following the completion of this municipal climate action plan.

The ICLEI program has five steps, referred to as "Milestones." Milestone 1, creating the GHG inventory has been completed. Milestone 2 and Milestone 3 require the creation of a target reduction of emissions and the development of a plan to meet this target. This report and associated analysis provide the information necessary for addressing Milestone 2 and the roadmap to satisfy Milestone 3. This analysis provides four measure-specific plans to reduce emissions by more than 20%. The framework associated with this material will support the City in meeting the requirements of Milestone 4 (implementation) and Milestone 5 (monitoring and adjustment). The framework facilitates the integration of new and revised information, taking advantage of new opportunities and allowing adjustments to under performing initiatives.

The analysis, and resulting GHG emissions reduction plans, incorporate many opportunities in the various contributing sectors (Buildings, Fleet, Commute, Water and Wastewater, Streetlights, and Photovoltaic Systems), as identified by City Staff utilizing the best available information at the time of research. The results provide an emissions impact estimate for the five plans with the corresponding financial analysis.

The results for each plan include the GHG emissions reduction expressed in metric tons CO₂e³ and as a percentage of the total City GHG emissions in 2000 and 2006. These results are presented with a number of other important metrics, including the Internal Rate of Return (IRR) and Net Present Value (NPV) of each plan. These are critical in the financial evaluation of the "investment." Other information includes the budget resources not devoted to purchasing energy and not sent to the fuel companies, and the value of the resources redirected to local investments. Plan C, for example, results in over \$41 million in local investment over the 25 year life of the plan.

The intent of this work is to allow the independent plans to be considered on their merits in numerous areas. This provides the ability to compare the comprehensive costs and benefits of competing paths, and thereby allow Policy Makers the ability to select the most appropriate path to reducing global warming pollution emissions in the City of Roseville. Five Action Plans are presented resulting in reductions from 0% to over 39% below 2000 levels by 2015. Each plan has advantages and challenges, which are described in the following sections of this report.

¹ City of Roseville web site, <http://www.roseville.ca.us/>

² International Council for Local Environmental Initiatives

³ CO₂e: Equivalent CO₂ in lbs or tons.

Background

Many California local jurisdictions (cities and counties) have recognized the increasing public concern about climate change and have committed to developing plans to meet this challenge. These initiatives coincide with aggressive actions by the State to address climate change.⁴ The rules and potential mandates from the State are under development. While the specific requirements are evolving, it is clear that all sectors including local government will be encouraged or even required to join the effort to reduce greenhouse gas emissions. Local governments are already demonstrating leadership by setting reduction targets and developing GHG emissions action plans.

The first step, documenting the emissions produced by the internal operations has been completed for the City of Roseville controlled equipment and operations. The total emissions for 2000 were roughly 22,971 metric tons of CO₂e. In addition to this baseline, there were numerous changes in GHG emissions identified from the utility billing since the baseline year of 2000. These are consolidated and modeled in the analysis as the "End Use" entries in the table below.⁵ These add another 12,118 tons to the reduction goal. This information was also used to generate the emissions trend associated with projected city growth from 2009 to 2015. These projected additional GHG emissions are included in the calculations of each Plan. This adds 404 tons per year which is dependant on the projected population increase each year within the City.

Traffic Signal-Head Retrofits

Roseville has installed 2,539 traffic signal heads, 914 pedestrian signal heads, and 16 internally illuminated street name signs from traditional incandescent light bulbs to energy efficient LED's (Light Emitting Diodes). The result is a 300,900 kwh (kilowatt hour) monthly reduction in energy consumption, and energy cost savings over \$24,900 a month in – almost \$300,000 a year!

Increases in Energy Consumption from 2000 to 2008			
End Use	kWh	Therms	Fuel (gals)
Bldg&Park Maint/Gen Proj Redev.	384,515	0	0
Fire Oper/Elect Oper Cntr/Bldg Maint	649,767	0	0
Police/Park Maint/Bldg Maint	773,498	0	0
Police/Diamond Oaks/Bldg Maint	966,913	0	0
Buildings	0	1,130,656	0
Water/Wastewater	9,705,644	0	0
Streetlights	1,589,684	0	0
Signals	-1,279,904	0	0
Fleet Additions	0	0	110,978
Commute	0	0	98,764
Totals	13,921,396	1,130,656	209,742
CO ₂ e (metric tons)	3,819	6,329	1,970

Table 1: Increases in Energy Consumption from 2000 to 2008

⁴ California's major initiatives for reducing climate change or greenhouse gas (GHG) emissions are outlined in the 2006 legislation [Assembly Bill 32, 2005 Executive Order](#) and a 2004 ARB regulation to reduce [passenger car](#) GHG emissions. These efforts aim at reducing GHG emissions to 1990 levels by 2020 - a reduction of about 25 percent, and then an 80 percent reduction below 1990 levels by 2050 and also includes the California Renewable Portfolio Standard for the production of electricity, and the California Low Carbon Fuel Standard recently adopted.

⁵ These End Uses represent 100% of the energy increases for all accounts as identified in the city's billing data. They are labeled as the accounts contributing most to the change.

The total emissions for 2006 were roughly 28,858 metric tons of CO₂e. The City of Roseville emissions by sector for 2006 are presented as a percentage of the total emissions from city controlled sources in Figure 1 below.

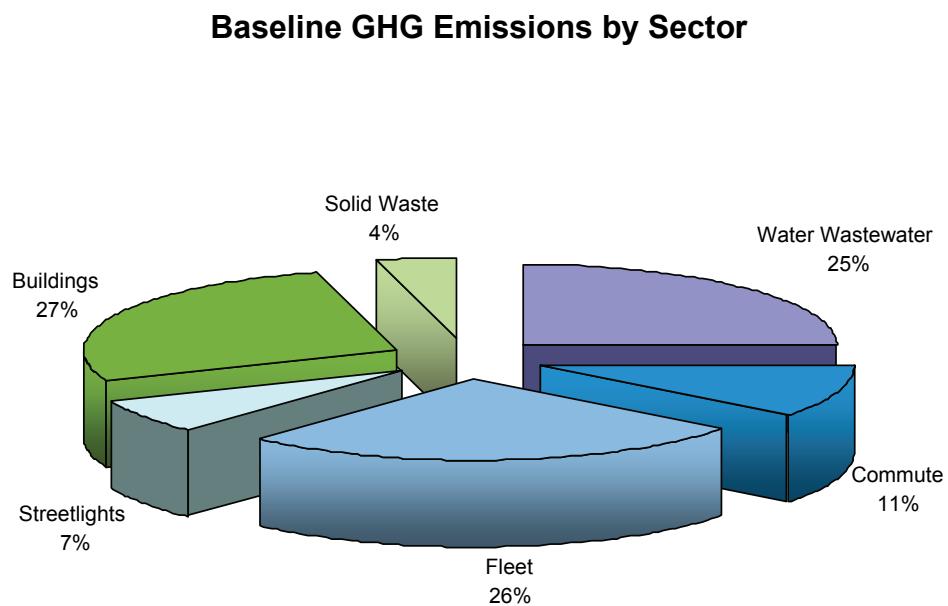


Figure 1: City of Roseville GHG Inventory as a Percentage of the 2006 Total⁶

Many of the measures available to reduce GHG emissions will also reduce the City fuel, electricity and natural gas costs. These costs are a significant element of the municipal budget, and the potential cost volatility represents a threat beyond the control of City Staff. Figure 2 below provides the trends for the annual energy costs based on four utility rate escalation scenarios. The 3.5% escalation rate reflects the current trend in utility energy cost for the commercial sector in California. The “current” cost trend for fleet fuel is 7.8% per year based on the costs from 1987-2006.⁷ These values are used in the cash flow projections for each GHG reduction plan. The fuel, electricity and natural gas related measures contained in this analysis will reduce the vulnerability to rising energy costs.

The context of resource uncertainty and the possibility of unrestrained energy cost escalation reinforce the need for a comprehensive review of how energy is consumed and where it can be conserved throughout all sectors of city operations.

⁶ The data supporting the 2000 and 2006 baseline calculations is provided in the appendices.

⁷ http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_usA.htm; See the appendices for the yearly published value.

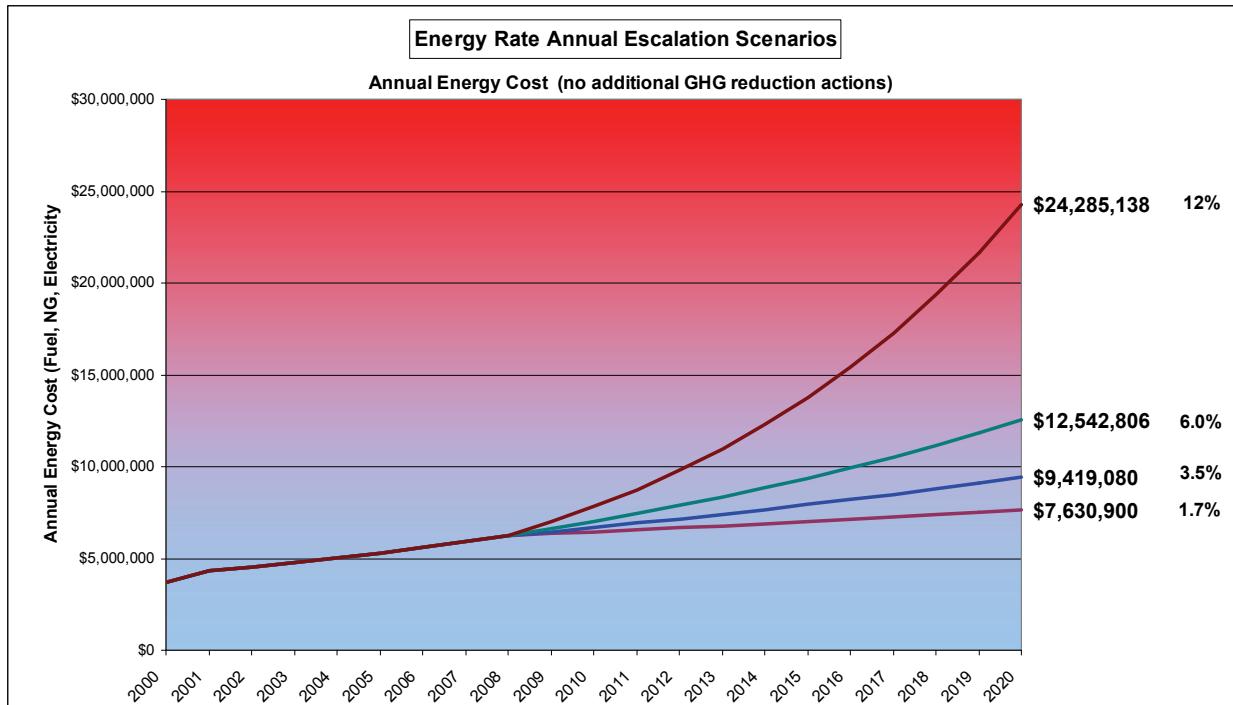


Figure 2: Energy Rate Escalation Scenarios

The volatility of vehicle fuel cost is particularly alarming when considering the potential impact on municipal budgets. Figure 3 below illustrates the magnitude of this vulnerability.

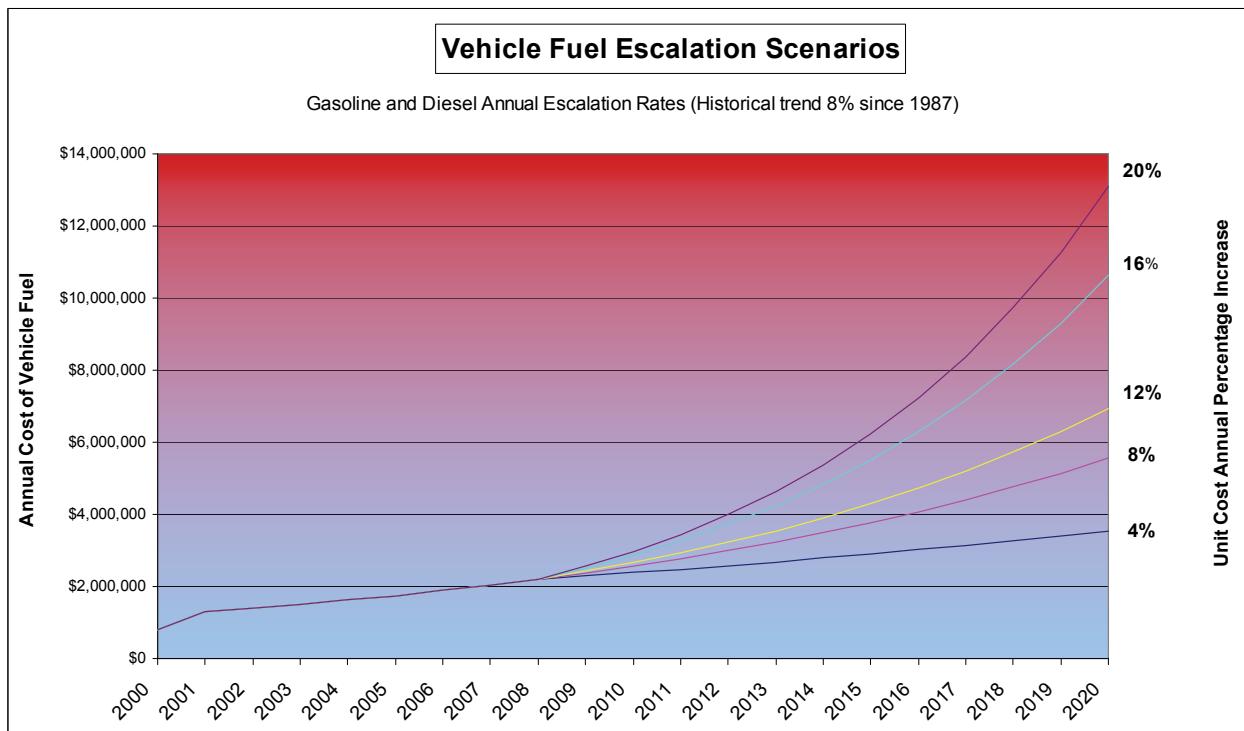


Figure 3: Annual Cost Trend of Vehicle Fuel Only

Methodology

The Roseville GHG emissions inventory was established using utility and city data for 2000 and 2006. In addition, a thorough 2006 emissions inventory for city operations was completed in 2008 and provides a reference for the baseline inventory developed for this analysis.⁸ The specific actions and events affecting this baseline from 2000 to 2008, either positive or negative, are factored into the inventory and the resulting trend. The 2000 baseline details used in this analysis are available in the appendices.

The options for future action by the City are comprised of measures applicable to building and equipment energy efficiency, fuel efficiency, alternative fuel options, and distributed energy generation. These options have been identified and quantified within this analysis using the best available information at the time of analysis. They are evaluated and presented as individual projects (measures), and as groups of measures (plans). Each is assigned a status (completed or future) and an implementation date to enable the calculation of cash flows over the life of the plans and the creation of energy cost trend graphs.

The measures are grouped to create comprehensive GHG emissions reduction plans. Each of the plans is analyzed to provide profiles enabling the evaluation of the plans individually and in comparison to the other plan options. Measures of specific data such as capital cost, year of implementation, financing, energy and cost savings were processed to provide the following information for the five action plans:

- Emissions reduction in tons CO2e avoided as a percentage of baseline
- CO2e reduction by sector
- Annual Cash Flow including debt service, replacement cost, incremental O&M⁹ costs
- Outstanding principal and debt service by year
- Simple Payback (SPB) for each plan
- Internal Rate of Return (IRR) for each plan
- Net Present Value (NPV) for each plan
- Avoided utility company payments (NPV over life of plan)
- Avoided fuel purchases (NPV over life of plan)
- Value invested locally in emission reduction projects

A measure evaluation matrix was employed to quantify both objective and subjective considerations to allow their inclusion in the planning process. The evaluation scoring contributes to the understanding of the opportunities but is not intended to provide a final ranking of the measures. The decision to include measures in each plan is dependent on its role in achieving the objective of that plan, and is therefore independent of any fixed criteria or ranking. The results of the evaluation are provided in the appendices.

LEED Certified Mahany Library

The new library at Mahany Park was designed and constructed with the goal of LEED certification. When completed it will be the first LEED certified building owned by the City, and only the second operating in the City of Roseville. LEED certification is expected to cost the City an additional 2% in construction costs, and should save the City \$50 per sq. ft. in employee and other costs over the life of the building, a savings of \$1.5 million.

⁸ 2006 and 2007 City of Roseville Greenhouse Gas Footprint Study, KEMA, March 2008, revised February 2009.

⁹ Operation and Maintenance costs do not include fuel and energy costs which are handled separately.

Results

Five plans have been created for consideration by the City of Roseville. These plans consist of a number of specific energy conservation measures which will reduce GHG emissions, reduce energy costs, address equipment issues, and reduce the uncertainty of the City's future annual energy budget. Figure 4 below illustrates the significant impact on energy costs achieved by aggressive actions to reduce energy consumption. Plan A represents no further actions.

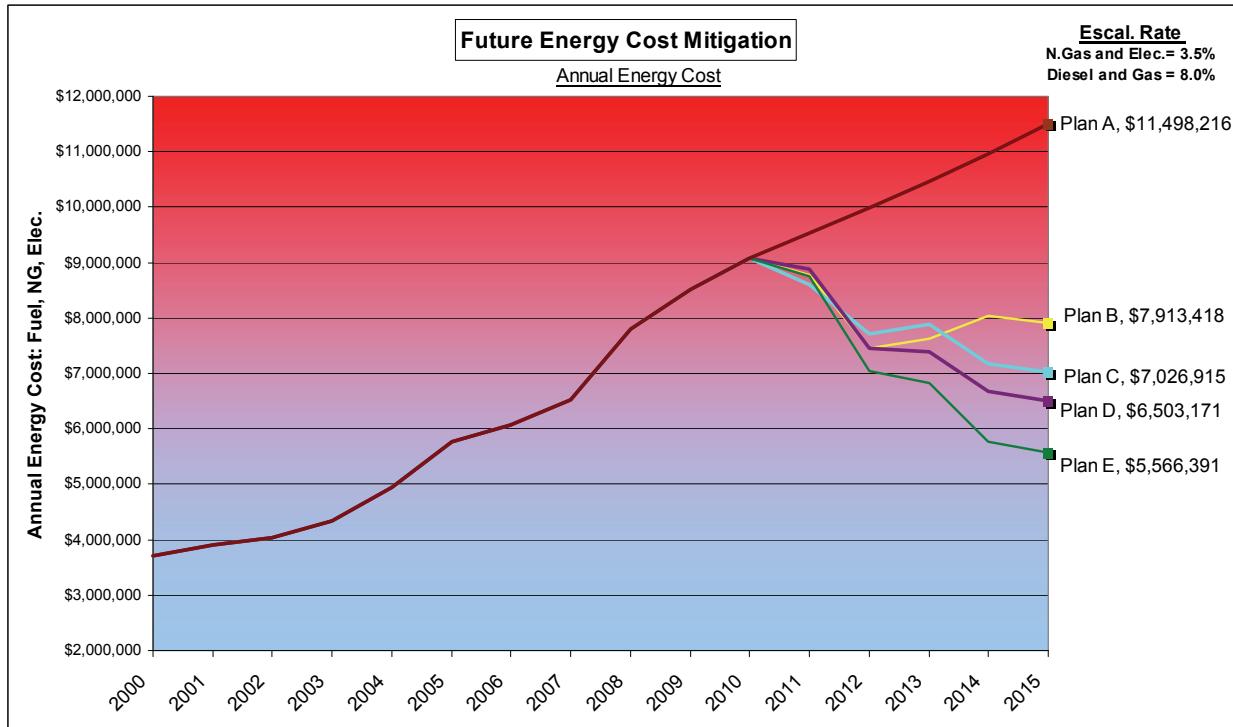


Figure 4: Annual Energy Costs for Each Action Plan

Table 2 below provides a comparison of each plan included in the figure above. The "% Reduction" is the amount of CO₂e reduced as a percentage of the total City emissions in the year indicated. Each plan achieves the reduction by a unique set of specific energy reduction measures. Plan E for example includes 26 measures reducing the City's emissions by approximately 39% below year 2000 emissions by 2015. The attractive financial results reflect the incorporation of several measures funded by the Federal Stimulus Program and assumes no cost to the city. The financial analysis is provided for each plan.

The following table provides these key characteristics for each plan:

- 1) Percentage reduction in CO₂e emissions below 2000 and 2006 levels
- 2) The jobs created based on total investment
- 3) Internal Rate of Return (IRR) based on the 25 year cash flow of each plan
- 4) Net Present Value calculated over the years 2009 to 2034 (25 years)
- 5) Net Cash Flow to the city including the initial investment, loan payments (for measures financed), O&M costs and savings, and energy cost savings of each plan

GHG Action Plan Summary					
Analysis	Plan A	Plan B	Plan C	Plan D	Plan E
Net Reduction below 2000 by 2015	-15.2%	19.8%	22.8%	26.6%	38.7%
Net Reduction below 2006 by 2015	8.3%	36.1%	38.5%	41.6%	51.2%
Jobs Created	0.0	1161.9	669.9	1178.1	1850.0
Net Capital Cost	\$0	\$26,817,840	\$28,967,983	\$36,055,010	\$73,082,596
Internal Rate of Return (IRR)	0.0%	16.4%	80.1%	31.6%	912.5%
Net Present Value (NPV)	\$0	\$11,194,973	\$35,187,890	\$26,762,975	\$46,321,399
Annual Net Cash Flow	Plan A	Plan B	Plan C	Plan D	Plan E
2009	\$0	\$0	\$0	\$0	\$0
2010	\$0	(\$101,500)	(\$101,500)	(\$151,500)	(\$51,500)
2011	\$0	(\$1,040,764)	(\$307,034)	(\$478,482)	(\$313,607)
2012	\$0	(\$752,571)	(\$237,020)	(\$370,977)	\$500,261
2013	\$0	(\$880,858)	\$76,822	(\$535,291)	\$1,936,260
2014	\$0	(\$837,557)	\$172,433	(\$444,867)	\$2,035,020
2015	\$0	(\$143,927)	\$920,576	\$297,871	\$2,066,110
2016	\$0	(\$83,195)	\$1,038,116	\$409,779	\$2,186,404
2017	\$0	(\$20,930)	\$1,159,583	\$525,376	\$2,310,396
2018	\$0	\$42,897	\$1,285,104	\$644,781	\$2,438,193
2019	\$0	\$108,313	\$1,414,811	\$768,114	\$2,569,903
2020	\$0	(\$706,283)	\$1,548,839	\$895,500	\$976,469
2021	\$0	\$1,025,252	\$2,097,543	\$1,383,723	\$2,845,516
2022	\$0	\$1,145,276	\$2,309,753	\$1,588,721	\$3,058,764
2023	\$0	\$1,642,832	\$3,505,304	\$2,776,757	\$3,829,452
2024	\$0	\$1,716,579	\$3,658,060	\$2,921,681	\$3,982,461
2025	\$0	\$1,792,065	\$3,815,879	\$3,071,339	\$4,140,094

Table 2: Action Plan Financial Results

The details for each plan are provided within this section beginning with Plan A on page 37. It should be noted that Plan A represents no further energy efficiency actions, and includes the GHG reductions associated with the traffic improvements as “local carbon offsets”.

The financial analysis provided for each plan includes the critical metrics of Internal Rate of Return (IRR) and Net Present Value (NPV). These provide important information to evaluate the worthiness of the investment from a cash flow perspective. It is important to note that the cash flows include annual O&M cost (or benefits) and the large inverter replacement costs of city financed photovoltaic systems replaced after 10 years. Some plans also employ power purchase agreements¹⁰ for a number of the PV systems where the cost of the inverter replacement is included in the agreement along with other O&M costs during the life of the contract.

The reduction in greenhouse gas emissions over time are presented in Figure 5 below. These trends are based on the following key considerations:

- 1) Actions contained in each plan (Plan A represents no further projects),
- 2) The enactment of a city policy of no further growth in total city employment (2009-2015)
- 3) No increase in the number of city vehicles (2009 – 2015)
- 4) The projected Power Content of the electricity provided by Roseville Electric
- 5) The impact of the CA Low Carbon Fuel Standard.

The significantly lower emissions in years 2000 and 2006 represent “good water years” for the utility. The resulting availability of hydroelectric supplied energy resulted in a much lower power content. The values used in this analysis are in Table 10 within the Methodology Section. Additional detail is provided in the appendices, page 129.

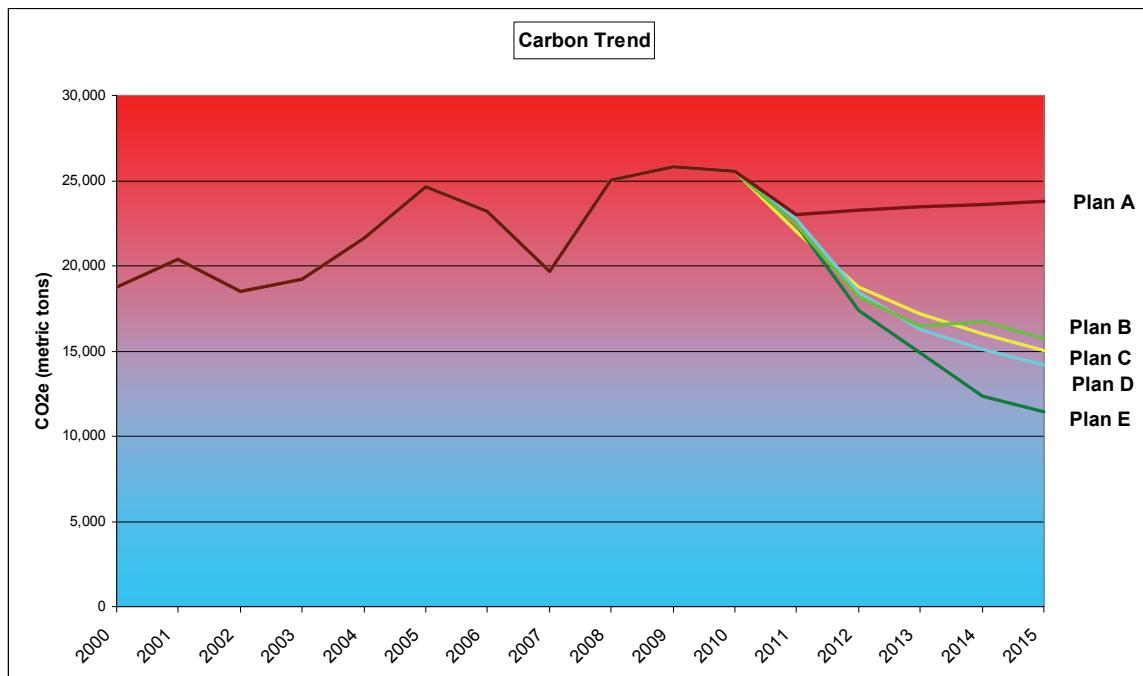


Figure 5: CO2e per Year for Plans A through E

¹⁰ See Section 4.0 Methodology for discussion of funding options.

The Carbon Density Trend (tons CO₂e / person) is provided in the table below, based on the past and projected population of the City of Roseville. These results are also heavily influenced by the power content of the electricity supplied by Roseville electric. The trend downward from 2009 to 2015 for Plan A (no further action) reflects a projected increase in population, improving power content, and impacts of the CA Low Carbon Fuel Program as well as policy limits on employee growth and city fleet expansion from 2009 to 2015.

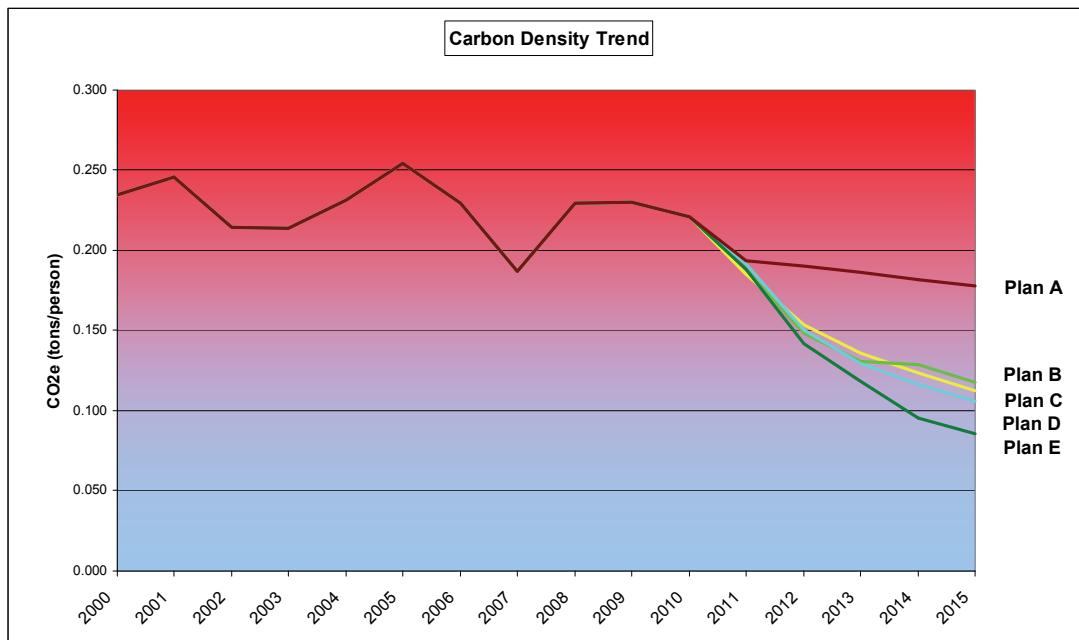


Figure 6: City of Roseville Carbon Density (CO₂e per Citizen)

California is projected to continue growing over the next decade. Figure 5 and Figure 6 both contain valuable information for understanding the challenges and opportunities of greenhouse gas reduction within communities that are planning responsibly for a share of California's growth. Logic would suggest that population growth within jurisdictions with a low carbon density would be a positive trend with respect to reducing overall greenhouse gas levels, if the growth is from high carbon density regions. This consideration would apply to the community wide carbon density evaluations which would also include the emissions documented in this report.

Action Plan Details

The measures used in this analysis are provided in the tables below. The first five columns indicate which measure is included in each Action Plan. More information on the measures is available in the Measure Details section of the report. It is important to note that some measures are mutually exclusive. Measures 18 and 19, for example apply to the same set of equipment, the City fleet. Measure 19 is more aggressive affecting more vehicles. A plan would select only one of these measures. These tables also include the implementation date and method of funded, both of which have significant influence on the net cash flow of plans utilizing the measure.

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	y	y	y	y	1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	no	yes
n	y	y	y	y	2	Building Solar Thermal (PPA Funded)	2010	no	no
n	y	y	y	n	3	City Facilities Energy Efficiency (City Funded)	2011	yes	no
n	n	n	n	y	4	City Facilities Energy Efficiency (Federal Stimulus Funded)	2011	no	yes
n	n	n	n	y	5	Streetlighting HID to LED (Federal Stimulus Funded)	2012	no	yes
n	n	n	y	n	6	Streetlighting HID to LED 40% Fixtures	2012	yes	no
n	n	n	y	n	7	Streetlighting HID to LED 40% Fixtures	2012	yes	no
n	n	y	n	n	8	Streetlighting Reduce Residential Lumins 50%	2010	yes	no
n	n	n	n	n	9	Streetlighting Residential Darken First 50% of Fixtures	2010	no	no
n	n	n	n	n	10	Streetlighting Residential Darken Second 50% of Fixtures	2010	no	no
n	y	y	y	y	11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	yes	no
n	y	y	y	n	12	Grease to Gas Dry Creek WWTP partnered with CoGen (City Funded)	2012	yes	no
n	n	n	n	y	13	Grease to Gas Dry Creek WWTP partnered with CoGen (Grant Funded)	2012	no	yes
n	y	y	y	y	14	Co Gen Linked to Dry Creek Grease to Gas	2012	yes	no

Table 3: Measures 1 – 14

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	15	Transit Bus Replacement Strategy A	2011	yes	no
n	n	y	y	y	16	Transit Bus Replacement Strategy B	2011	yes	no
n	n	y	y	y	17	Fleet Management Software Efficiency Initiatives	2010	no	no
n	y	n	n	n	18	Fleet Replacement Strategy A	2011	yes	no
n	n	y	y	y	19	Fleet Replacement Strategy B	2012	yes	no
n	n	n	n	n	20	Biodiesel 5%	2010	no	no
n	n	n	n	n	21	Biodiesel 20%	2010	no	no
n	n	n	n	n	22	Biodiesel 50%	2010	no	no
n	n	n	n	n	23	Biodiesel 99%	2010	no	no
n	y	n	n	n	24	Biodiesel 20% linked to Fleet A	2010	no	no
n	n	y	n	n	25	Biodiesel 20% Linked to Fleet B	2010	no	no
n	n	n	n	n	26	Biodiesel 50% linked to Fleet A	2010	no	no
n	n	n	n	n	27	Biodiesel 50% Linked to Fleet B	2010	no	no
n	n	n	n	n	28	Biodiesel 99% Linked to Fleet A	2010	no	no
n	n	n	y	y	29	Biodiesel 99% Linked to Fleet B	2010	no	no
n	y	y	y	y	30	Commute Program Enhancement A	2010	no	no
n	n	y	y	y	31	Commute Program Enhancement B	2011	no	no
n	n	n	n	y	32	Staff Efficiency Engineer	2010	no	no
n	n	n	y	y	33	Staff Efficiency Coordinator	2010	no	no

Table 4: Measures 15 – 33

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	34	PV 500 kW DC PPA (unspecified location)	2010	no	no
n	y	n	n	n	35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	2010	yes	no
n	y	n	y	y	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	no	no
n	y	n	n	n	37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	2010	yes	no
n	n	n	n	y	38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	2010	no	yes
n	y	y	y	n	39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012	no	no
n	n	n	n	y	40	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	no	no
n	n	n	n	y	42	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	no	no
n	n	n	n	y	44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	no	no
n	n	n	n	y	46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	2010	no	yes
n	n	n	n	n	47	PV 1.0 MW DC (Single Axis)- Roseville Energy Park (Stimulus funded)	2010	no	yes
n	n	n	n	n	48	PV 1.74 MW DC (Fixed Tilt)- Brownfield Site (Stimulus funded)	2010	no	yes
n	n	y	y	y	49	PV 320 kW DC (Fixed Tilt) Energy Source for Electric Vehicles (New Fleet B) PPA	2012	no	no
n	y	n	n	y	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	no	no

Table 5: Measures 34 – 50 Photovoltaic Projects

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	51	Energy Efficient Appliance Rebate Program (local offset)	2012	no	yes
n	n	n	n	n	52	HVAC Maintenance Energy Efficiency Program (local offset)	2012	no	yes
n	n	n	n	n	53	Non-Residential On-site audits (local offset)	2012	no	yes
n	n	n	n	n	54	Residential and Commercial Energy Efficiency and Solar Loan funding (local offset)	2014	no	yes
n	n	n	n	n	55	Residential Duct Testing and Sealing (local offset)	2013	no	yes
n	n	n	n	n	56	Residential New Construction M&V Programs (local offset)	2013	no	yes
n	n	n	n	n	57	Residential On-site audit and energy efficiency upgrades program (local offset)	2014	no	yes
n	n	n	n	n	58	Residential Solar Electric Generation programs (local offset)	2012	no	yes
n	n	n	n	n	59	Weatherization Assistance (local offset)	2011	no	yes
n	n	n	n	y	60	Water Efficiency Upgrade Project-retrofit of parks (Stimulus funded)	2012	no	yes
n	n	y	y	n	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	yes	no
n	n	n	n	n	62	Direct Load Control Project (local offset)	2014	no	yes
n	n	n	n	n	63	Business Solar Energy Installation (local offset)	2010	no	yes
y	y	y	y	y	64	Traffic Operational Improvements '04-'05 (Offset)	2005	no	no
y	y	y	y	y	65	Traffic Operational Improvements '06-'07 (Offset)	2007	no	no
y	y	y	y	y	66	Traffic Operational Improvements '08-'09 (Offset)	2009	no	no
n	n	n	n	y	67	Traffic Operational Improvements '10-'12 (Offset)	2012	no	yes
n	n	n	n	y	68	Traffic Operational Improvements '13-'15 (Offset)	2014	no	yes

Table 6: Measures 51 – 68 Stimulus Funded and Local Carbon Offset Projects

The projects included in Table 7 below have been included in the analysis reflecting a reduction of energy consumption in the years prior to 2009. Measure 69, implemented in 1997 predates this analysis. However, the energy produced reduces the energy consumption of the Roseville Aquatic Center which is reflected in the facility's billing information utilized in this work.

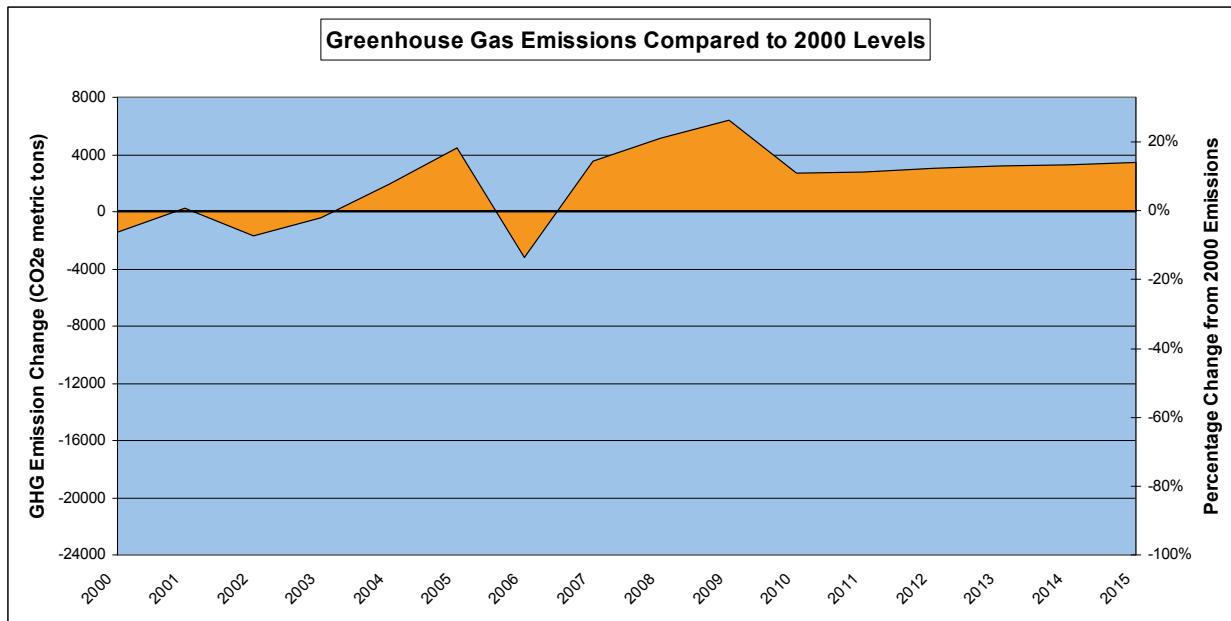
Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
y	y	y	y	y	69	PV 8 kW AC RSVL Aquatic CTR (predates analysis)	1997	no	no
y	y	y	y	y	70	PV 18.6 kW AC Fire Station #6	2002	no	no
y	y	y	y	y	71	PV 10 kW AC Middle School	2006	no	no
y	y	y	y	y	72	PV 10 kW AC City Hall	2006	no	no
y	y	y	y	y	73	City Various Buildings - Lighting: 13 Locations	2002	no	no
y	y	y	y	y	74	Various - Vending Misers and Chiller: Oak St and Main Library	2003	no	no
y	y	y	y	y	75	Dry Creek Motors	2004	no	no
y	y	y	y	y	76	Police Department and Maidu Library	2004	no	no
y	y	y	y	y	77	Corp Yard Task Lighting	2005	no	no
y	y	y	y	y	78	Multiple Building Energy Efficiency Measures	2007	no	no

Table 7: Completed Projects

Plan A:	-3,484	Tons CO ₂ e Avoided	-15.2%	% Reduction
Community Benefit (over 25 year life of plan)			Net Capital Cost	\$0
\$\$\$ Avoided Utility Company Payments	\$0		Jobs	0.0
\$\$\$ Avoided Fuel Purchases	\$0		IRR	0.0%
\$\$\$ Invested Locally in GHG Projects	\$0		NPV	\$0

Action Plan A: The City has the option of no future actions to reduce greenhouse gas emissions. This option would be a stark departure from the city's history of employing the best management practices available to reduce energy consumption. However, Plan A representing this option is included to provide a reference point for the other four options. This no action plan includes the local carbon offsets of the completed traffic operational improvements (Measures 64 through 66)¹¹ and the completed PV and efficiency projects (Measures 69 through 78). Even with these emissions reducing actions, there is a net gain of almost 3,500 metric tons of Co₂e, a 15% increase above 2000 levels. This increase is driven by the population gain and the associated expansion of city services, represented in Table 9, on page 28.

The figure below provides the emissions trend from 2000 to 2015. The trend reversals in years prior to 2006 are a result of the changing power content of the energy provided by Roseville Electric.¹² The significant decreases in 2006 and 2010 result from the reductions associated with the traffic improvement projects completed in 2005 and 2009.



¹¹ The emissions reduction associated with the traffic operational improvements are included in all plans.

¹² The power content is dependant on the source energy used to generate the electricity provided to the city, expressed as lbs CO₂e/kWh. The value is heavily dependant on the availability of hydroelectric energy and varies from 0.495 lbs/kWh in 2000 to 0.768 lbs/kWh in 2009.

Plan B: 4,541 Tons CO2e Avoided	19.8%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$26,817,840
\$\$\$ Avoided Utility Company Payments	Jobs	1,161.9
\$\$\$ Avoided Fuel Purchases	IRR	16.4%
\$\$\$ Invested Locally in GHG Projects	NPV	\$11,194,973

Action Plan B: The plan includes a combination of 18 new measures including eight Photovoltaic systems ranging from 160 kW to 4.7 MW utilizing both standard financing and power purchase agreement funding strategies. This plan also includes a broad range of energy and energy efficiency measures for the city buildings, fleet and wastewater system. The fleet measures are less aggressive including a range of plug in gasoline-electric hybrid sedans (PHEV) and hybrid truck vehicle replacements. This plan also includes the cogeneration projects proposed for the Pleasant Grove and Dry Creek wastewater treatment plants and the associated Grease to Gas methane generation project. Plan B provides for a net reduction of 20% below 2000 emissions levels (36.5% below 2006) with a reasonable internal rate of return of over 30%.

Plan B Measure List			Plan B Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2010	(\$101,500)
3	City Facilities Energy Efficiency (City funded)	2011	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	2011	(\$1,040,764)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2012	(\$752,571)
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2013	(\$880,858)
14	Co Gen Linked to Dry Creek Grease to Gas	2012	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2014	(\$837,557)
18	Fleet Replacement Strategy A	2011				2015	(\$143,927)
24	Biodiesel 20% linked to Fleet A	2010				2016	(\$83,195)
30	Commute Program Enhancement A	2010				2017	(\$20,930)
35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	2010				2018	\$42,897
36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011				2019	\$108,313
37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	2010				2020	(\$706,283)
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012				2021	\$1,025,252
41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010				2022	\$1,145,276
						2023	\$1,642,832
						2024	\$1,716,579
						2025	\$1,792,065

Plan C: 5,237 Tons CO2e Avoided	22.8%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$28,967,983
\$\$\$ Avoided Utility Company Payments	Jobs	669.9
\$\$\$ Avoided Fuel Purchases	IRR	80.1%
\$\$\$ Invested Locally in GHG Projects	NPV	\$35,187,890

Action Plan C: This plan includes 19 measures and improves the investment results by replacing four of the photovoltaic projects with the parks water efficiency project funded by the city and a much more aggressive fleet and transit bus replacement strategy. This plan also employs a street lighting energy reduction measure. Plan C exceeds the reductions of Plan B, achieving a projected 23% GHG emissions reduction by 2015 with very attractive financial metrics, and over \$33 Million invested locally over the life of the plan. The Internal Rate of Return is over 150% and the Net Present Value exceeds \$40 million over the term of the analysis (25 years). The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is negative for a number of years then turns strongly positive in 2013. The use of power purchase agreements for the photovoltaic projects improves the cost / benefits results for this comprehensive strategy.

Plan C Measure List			Plan C Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2010	(\$101,500)
3	City Facilities Energy Efficiency (City funded)	2011	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2011	(\$307,034)
8	Streetlighting Reduce Residential Lumins (50%)	2010	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2012	(\$237,020)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	2013	\$76,822
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2014	\$172,433
14	Co Gen Linked to Dry Creek Grease to Gas	2012	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2015	\$920,576
16	Transit Bus Replacement Strategy B	2011	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2016	\$1,038,116
17	Fleet Management Software Eff. Initiatives	2010				2017	\$1,159,583
19	Fleet Replacement Strategy B	2012				2018	\$1,285,104
25	Biodiesel 20% Linked to Fleet B	2010				2019	\$1,414,811
30	Commute Program Enhancement A	2010				2020	\$1,548,839
31	Commute Program Enhancement B	2011				2021	\$2,097,543
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012				2022	\$2,309,753
						2023	\$3,505,304
						2024	\$3,658,060
						2025	\$3,815,879

Plan D: 6,208	Tons CO2 Avoided	27.0%	% Reduction
Community Benefit (over 25 year life of plan)			Financial Metrics
\$\$\$ Avoided Utility Company Payments	\$24,765,629	Jobs	1,076.7
\$\$\$ Avoided Fuel Purchases	\$12,403,057	IRR	47.4%
\$\$\$ Invested Locally in GHG Projects	\$42,296,043	NPV	\$32,710,548

Action Plan D: The plan includes a combination of 22 measures plus the three completed traffic operational improvements included in all plans. This plan pushes the GHG reduction to 27% below 2000 levels (42% below 2006) by including an aggressive street lighting strategy converting 80% of the fixtures to newly available LED technology. It also includes use of 99% biodiesel fuel for all vehicles other than public safety, as well as the aggressive fleet replacement strategy B and the parks water efficiency upgrade project. The cash flow includes the staff time of a full time “efficiency coordinator” calculated at \$60k (1 FTE) to support the implementation of this comprehensive set of energy and energy efficiency projects. The cash flow assumes city funding for all but one of the projects.

Plan D Measure List			Plan D Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	33	Staff Efficiency Coordinator	2010	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	2010	(\$151,500)
3	City Facilities Energy Efficiency (City funded)	2011	39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012	2011	(\$478,482)
6	Streetlighting HID to LED 40% Fixtures	2012	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	2012	(\$370,977)
7	Streetlighting HID to LED 40% Fixtures	2012	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2013	(\$535,291)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2014	(\$444,867)
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2015	\$297,871
14	Co Gen Linked to Dry Creek Grease to Gas	2012	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	2016	\$409,779
16	Transit Bus Replacement Strategy B	2011	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2017	\$525,376
17	Fleet Management Software Eff. Initiatives	2010	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2018	\$644,781
19	Fleet Replacement Strategy B	2012	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2019	\$768,114
29	Biodiesel 99% Linked to Fleet B	2010				2020	\$895,500
30	Commute Program Enhancement A	2010				2021	\$1,383,723
31	Commute Program Enhancement B	2011				2022	\$1,588,721
						2023	\$2,776,757
						2024	\$2,921,681
						2025	\$3,071,339

Plan E:	8,998	Tons CO2e Avoided	39.2%	% Reduction
Community Benefit (over 25 year life of plan)			Financial Metrics	
\$\$\$ Avoided Utility Company Payments	\$30,556,141	Jobs	1,748.6	
\$\$\$ Avoided Fuel Purchases	\$11,944,245	IRR	1074.6%	
\$\$\$ Invested Locally in GHG Projects	\$94,251,820	NPV	\$52,183,131	

Action Plan E: This plan includes 26 new measures including two future traffic operational improvement measures. In addition to most of the measures of Plan D, Plan E includes an Energy Engineer position and an additional large photovoltaic system. Contrary to Plan D, this strategy assumes Federal Stimulus Program funding for many of the projects which greatly improves the investment results. This best case scenario results in almost \$100 million invested locally in greenhouse gas emissions reduction projects over the life of the plan.

Plan E Measure List			Plan E Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	2010	2010	(\$51,500)
4	City Facilities Energy Efficiency (Federal Stimulus funded)	2011	40	PV 160 kW DC (Fixed Tilt) Downtown Parking (Stimulus Funded)	2010	2011	(\$313,607)
5	Streetlighting HID to LED (Federal Stimulus Funded)	2012	42	PV 230 kW DC (Fixed Tilt)- Mahany Pk Parking Area (Stimulus Funded)	2010	2012	\$500,261
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking (Stimulus Funded)	2010	2013	\$1,936,260
13	Grease to Gas Dry Creek WWTP (requires CoGen) (Grant Funded)	2012	46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	2010	2014	\$2,035,020
14	Co Gen Linked to Dry Creek Grease to Gas	2012	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2015	\$2,066,110
16	Transit Bus Replacement Strategy B	2011	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	2016	\$2,186,404
17	Fleet Management Software Eff. Initiatives	2010	60	Water Efficiency Upgrade Project- retrofit of parks (Stimulus funded)	2012	2017	\$2,310,396
19	Fleet Replacement Strategy B	2012	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2018	\$2,438,193
29	Biodiesel 99% Linked to Fleet B	2010	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2019	\$2,569,903
30	Commute Program Enhancement A	2010	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2020	\$976,469
31	Commute Program Enhancement B	2011	67	Traffic Operational Improvements '10-'12 (Offset)	2012	2021	\$2,845,516
32	Staff Efficiency Engineer	2010	68	Traffic Operational Improvements '13-'15 (Offset)	2014	2022	\$3,058,764
33	Staff Efficiency Coordinator	2010				2023	\$3,829,452
						2024	\$3,982,461
						2025	\$4,140,094

Summary

A greenhouse gas (GHG) emissions reduction of over 20% below 2000 levels by 2015 can be achieved by a number of paths documented in this report. Four paths, or Action Plans, are comprised of up to 26 new individual measures. The plans also include numerous projects completed since 2000 and incorporate the emissions trend into the future based on projected city growth. Each is evaluated for the financial costs and benefits they contribute to the overall strategy. The total “palette” of quantified opportunities includes 68 new measures to reduce energy consumption. The analysis model underpinning these results will be available for incorporating new information and technologies as they come available, as well as refining the analysis with monitored data. This comprehensive approach to addressing emissions reduction allows the City to meet a number of related goals, including improving the long term financial health of Roseville, reducing the budget vulnerability to future energy cost escalation, addressing the existing maintenance demands of aging equipment, and providing public demonstrations of commitment and progress in the highly visible challenge of greenhouse gas emissions reduction.

The information in this report allows the City to understand the challenges and opportunities available in reaching its goal to reduce emissions. The measure evaluation matrix quantifies the many related issues not captured by the financial results or emissions reduction such as public visibility and the resolution of existing problems. The financial results provide information on the investment value of the various paths of action, along with the anticipated net cash flow over time. The ability to understand the complex context of greenhouse gas emissions reduction will allow policy makers to define expected outcomes and associated financial commitments to achieve desired outcomes. This provides city staff the flexibility needed to effectively implement the policy. The individual measures within each plan may be delayed, modified or replaced as appropriate while remaining faithful to the policy directive. This flexibility will be essential given the dynamic nature of the regulatory environment and the rapidly evolving financial and technological opportunities in California.

In summary, this analytical framework and report organizes the city's data and documentation relating to energy efficiency and greenhouse gas emissions reduction. It is applied to the city objective of reducing greenhouse gas emissions, presenting four strategies to reduce emissions by 20% to 39% below 2000 levels by 2015. The database and analytical framework supporting this work are available into the future as new information and opportunities (technical and financial) emerge for consideration.

As a result of efforts to reduce paper waste, City of Roseville employees reduced paper use by over 700 reams between 2007 and 2008, a difference of 3.6 million sheets of paper!

2.0 Introduction

Public jurisdictions (cities and counties) have committed to developing action plans to reduce greenhouse gas emissions from government controlled sources. These detailed plans are an essential tool to provide a roadmap to accomplish the goals and provide a framework to track and verify the progress made over the life of the plan.

This report provides these capabilities by using an analysis method developed for California cities and applied to the City of Roseville. This method incorporates all measures across the various sectors (Building Efficiency, Fleet, Commute, Water and Wastewater, Streetlights, and Photovoltaic Systems), and provides an emissions impact estimate and a comprehensive financial analysis. Furthermore, this analysis allows independent plans to be analyzed, providing the capability to compare the costs and benefits of competing paths available to achieve meaningful emissions reduction.

The total emissions for 2006 were roughly 28,900 metric tons of CO₂e. The City of Roseville emissions by sector for 2006 are presented as a percentage of the total emissions from city controlled sources in Figure 7 below.

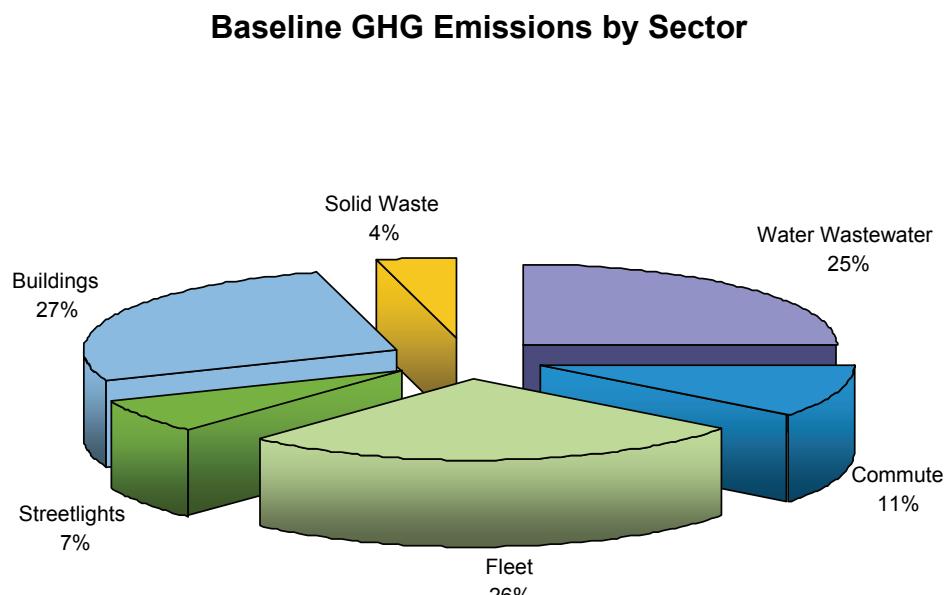


Figure 7: City of Roseville GHG Inventory as a Percentage of the 2006 Total

Energy Cost Trend

There is considerable discussion about the availability of fossil fuels in the near and middle term future (5 to 20 years). The “Peak Oil” movement suggests that we are at or near the point where our increased global demand for oil cannot be supplied from new petroleum discoveries while production from existing oil fields is waning. Similar arguments are made for natural gas supply vs. demand. If demand outstrips supply, simple economics indicate that the cost to consumers will escalate rapidly, until the global demand is sufficiently dampened and realigns with available supply.¹³ This issue has important implications for California jurisdictions. A significant portion of Roseville’s energy comes from natural gas.¹⁴ A large long term increase in the cost of this energy source will result in costly increases in the cost of electrical power, as well as the natural gas consumed directly by the city. Figure 8 below provides the trends for the annual cost of fleet fuel, utility supplied electricity and natural gas based on four rate escalation scenarios. These trend lines reflect no further action to reduce or increase its reliance on fleet fuel, and utility supplied electricity and natural gas.

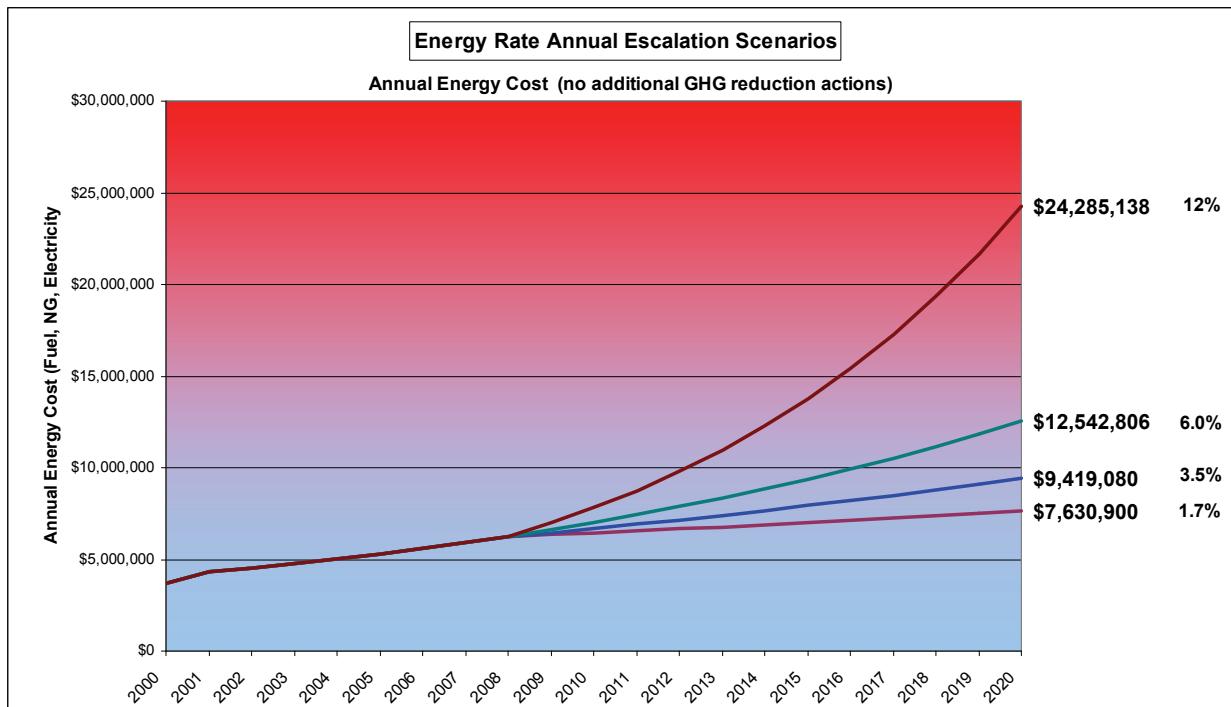


Figure 8: Energy Rate Escalation Scenarios

¹³ Hirsch, Robert. et al. (February 2005) “Peaking of World Oil Production: Impacts, Mitigation, & Risk Management.” SAIC.

¹⁴ For natural gas cost trends see *Natural Gas Cost Trends from 1989 to 2009* on page 156 in the appendices.

The cost of vehicle fuel (gasoline and diesel) has been much more volatile than the other energy sources in recent years. The cost of this resource has increased by 7.8% a year on average since 1987 (see the appendices for further discussion on the cost trends of vehicle fuel). If fuel increases continue at the 7.8% rate the future cost will follow the 8% line in Figure 9 below. However, if prices increase at twice the past rate (represented by the 16% line) then the annual cost of vehicle fuel will exceed \$10M by 2020. There are two significant new developments that will allow cities to mitigate this energy cost vulnerability. First, major advances in fuel efficiency have made it to the market in products ranging from hybrid passenger cars to a wide range of diesel hybrid work trucks. Second, California has adopted the Low Carbon Fuel policy requiring fuel that has a declining CO₂e density over the next decade. The emerging electric vehicle and biofuel industries also show significant promise.

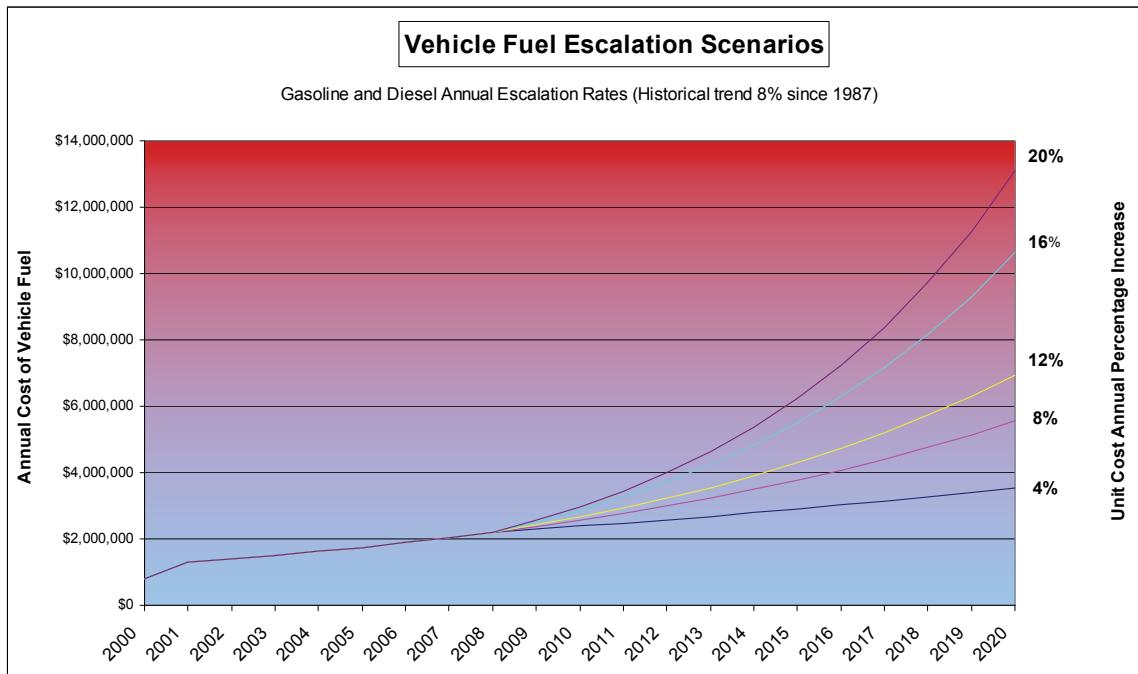
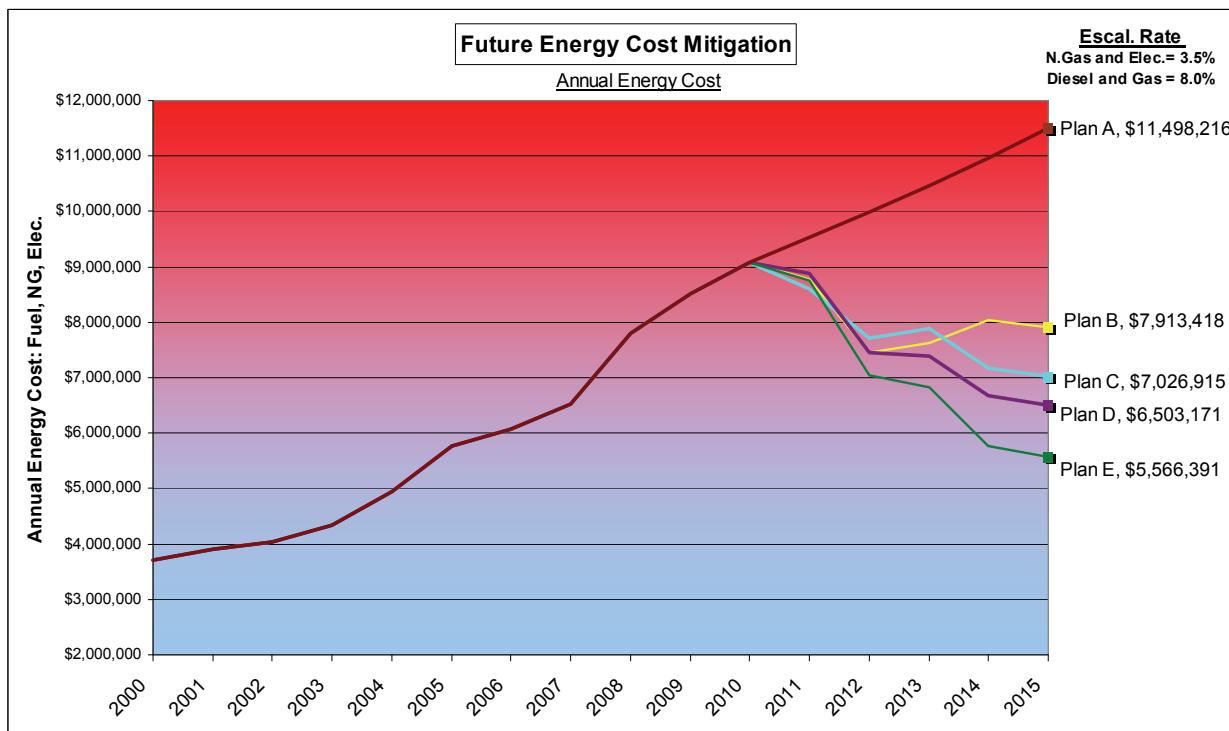


Figure 9: Annual Cost Trend of Vehicle Fuel Only

3.0 Results

Five plans have been created for consideration by the City of Roseville. These plans consist of numerous measures to reduce GHG emissions, reduce energy costs, address equipment problems, and reduce the volatility of the City's annual energy costs. Summary information is provided below. The Action Plan Evaluation provided in the appendices provides an analysis of the relative strengths of each combination of measures. Similar information for each measure is also provided.



GHG Impacts and Plan Financial Results

Table 8 below provides a comparison of each plan. The “% Reduction” is the amount of CO₂e reduced as a percentage of the total City emissions. Each plan meets the goal by a unique set of measures. Plan E identifies the measures necessary to reduce the City's emissions by approximately 39% below year 2000 emissions by 2015. The financial analysis is provided with each plan. The IRR and NPV results are based on the 25 year term of the analysis.

The following table provides these key characteristics for each plan:

- 1) Percentage reduction in CO₂e emissions below 2000 and 2006 levels
- 2) The jobs created based on total investment
- 3) Internal Rate of Return (IRR) based on the 25 year cash flow of each plan
- 4) Net Present Value calculated over the years 2009 to 2034 (25 years)
- 5) Net Cash Flow to the city including the initial investment, loan payments (for measures financed), O&M costs and savings, and energy cost savings of each plan

GHG Action Plan Summary					
Analysis	Plan A	Plan B	Plan C	Plan D	Plan E
Net Reduction below 2000 by 2015	-15.2%	19.8%	22.8%	26.6%	38.7%
Net Reduction below 2006 by 2015	8.3%	36.1%	38.5%	41.6%	51.2%
Jobs Created	0.0	1161.9	669.9	1178.1	1850.0
Net Capital Cost	\$0	\$26,817,840	\$28,967,983	\$36,055,010	\$73,082,596
Internal Rate of Return (IRR)	0.0%	16.4%	80.1%	31.6%	912.5%
Net Present Value (NPV)	\$0	\$11,194,973	\$35,187,890	\$26,762,975	\$46,321,399
Annual Net Cash Flow	Plan A	Plan B	Plan C	Plan D	Plan E
2009	\$0	\$0	\$0	\$0	\$0
2010	\$0	(\$101,500)	(\$101,500)	(\$151,500)	(\$51,500)
2011	\$0	(\$1,040,764)	(\$307,034)	(\$478,482)	(\$313,607)
2012	\$0	(\$752,571)	(\$237,020)	(\$370,977)	\$500,261
2013	\$0	(\$880,858)	\$76,822	(\$535,291)	\$1,936,260
2014	\$0	(\$837,557)	\$172,433	(\$444,867)	\$2,035,020
2015	\$0	(\$143,927)	\$920,576	\$297,871	\$2,066,110
2016	\$0	(\$83,195)	\$1,038,116	\$409,779	\$2,186,404
2017	\$0	(\$20,930)	\$1,159,583	\$525,376	\$2,310,396
2018	\$0	\$42,897	\$1,285,104	\$644,781	\$2,438,193
2019	\$0	\$108,313	\$1,414,811	\$768,114	\$2,569,903
2020	\$0	(\$706,283)	\$1,548,839	\$895,500	\$976,469
2021	\$0	\$1,025,252	\$2,097,543	\$1,383,723	\$2,845,516
2022	\$0	\$1,145,276	\$2,309,753	\$1,588,721	\$3,058,764
2023	\$0	\$1,642,832	\$3,505,304	\$2,776,757	\$3,829,452
2024	\$0	\$1,716,579	\$3,658,060	\$2,921,681	\$3,982,461
2025	\$0	\$1,792,065	\$3,815,879	\$3,071,339	\$4,140,094

Table 8: Action Plan Financial Results

The details for each plan are provided within this section beginning with Plan A on page 37. It should be noted that Plan A represents no further energy efficiency actions, and includes the GHG reductions associated with the traffic improvements as “local carbon offsets”.

The financial analysis provided for each plan includes the critical metrics of Internal Rate of Return (IRR) and Net Present Value (NPV). These provide important information to evaluate the worthiness of the investment from a cash flow perspective. It is important to note that the cash flows include annual O&M cost (or benefits) and the large inverter replacement costs of city financed photovoltaic systems replaced after 10 years. Some plans also employ power purchase agreements¹⁵ for a number of the PV systems where the cost of the inverter replacement are included in the agreement along with other O&M costs during the life of the contract..

The reduction in greenhouse gas emissions over time are presented in Figure 10 below. These trends are based on the following key considerations:

- 6) Actions contained in each plan (Plan A represents no further projects),
- 7) The enactment of a city policy of no further growth in total city employment (2009-2015)
- 8) No increase in the number of city vehicles (2009 – 2015)
- 9) The projected Power Content of the electricity provided by Roseville Electric
- 10) The impact of the CA Low Carbon Fuel Standard.

The significantly lower emissions in years 2000 and 2006 represent “good water years” for the utility. The resulting availability of hydroelectric supplied energy resulted in a much lower power content. The values used in this analysis are in Table 10 within the Methodology Section. Additional detail is provided in the appendices, page 129.

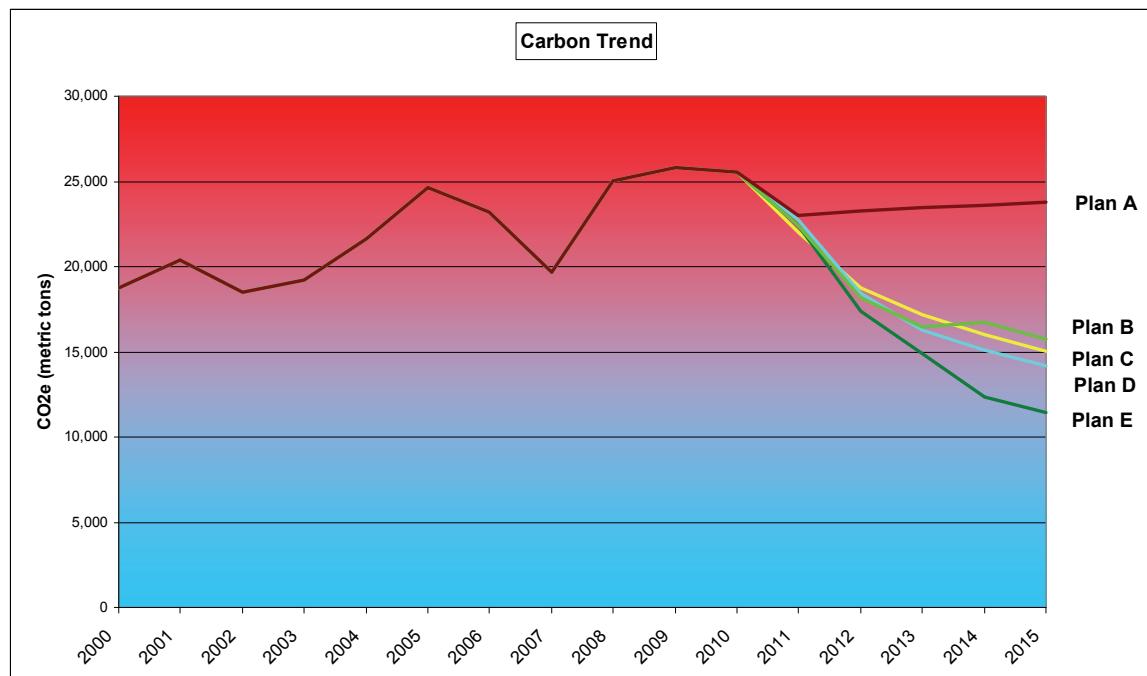


Figure 10: CO₂e per Year for Plans A through E

¹⁵ See Section 4.0 Methodology for discussion of funding options.

The Carbon Density Trend (lbs. CO₂e / person) is provided in the table below, based on the past and projected population of the City of Roseville. These results are also heavily influenced by the power content of the electricity supplied by Roseville electric. The trend downward from 2009 to 2015 for Plan A (no further action) reflects a projected increase in population, improving power content, and impacts of the CA Low Carbon Fuel Program as well as policy limits on employee growth and city fleet expansion from 2009 to 2015.

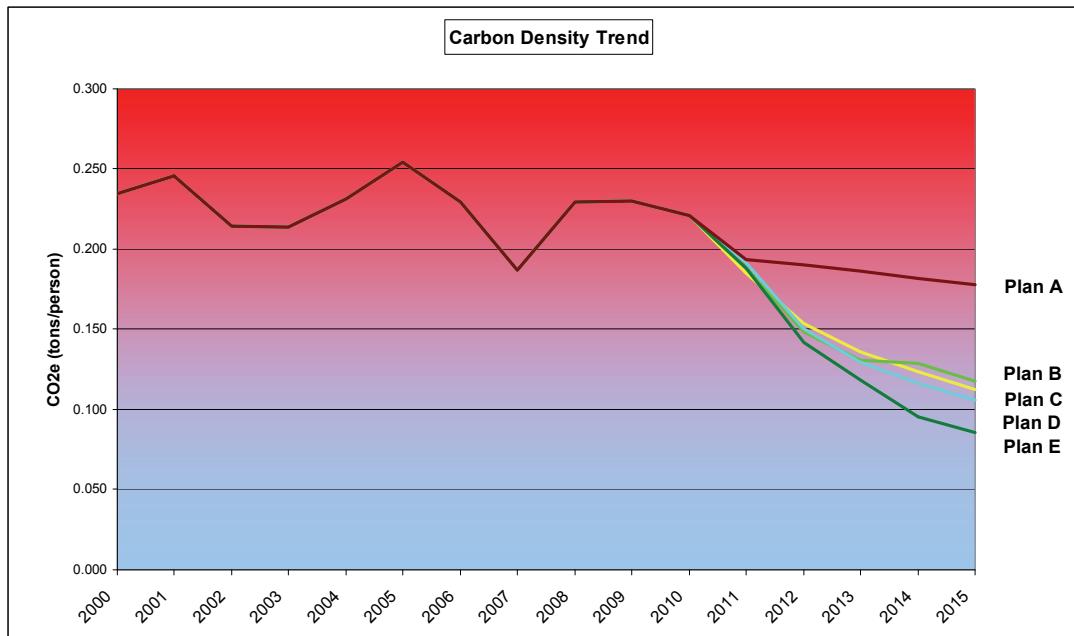


Figure 11: City of Roseville Carbon Density (CO₂e per Citizen)

California is projected to continue growing over the next decade. Figure 10 and Figure 11 both contain valuable information for understanding the challenges and opportunities of greenhouse gas reduction within communities that are planning responsibly for a share of California's growth. Logic would suggest that population growth within jurisdictions with a low carbon density would be a positive trend with respect to reducing overall greenhouse gas levels, if the growth is from high carbon density regions. This consideration would apply to the community wide carbon density evaluations which would also include the emissions documented in this report.

4.0 Methodology

Context

The Roseville GHG emissions inventory for 2006 has been completed and provides a reference for the baseline inventory developed for this analysis.¹⁶ Data has been collected allowing this analysis to create the year 2000 baseline also. The specific actions and events subsequent to 2000 either positive or negative are factored into the inventory and provide the basis for the projected emissions for the future years. The baseline inventory has been incorporated into this analysis using information made available by Staff at the initiation of this work.

The total emissions for 2000 were roughly 22,971 metric tons of CO2e (28,858 tons in 2006). In addition to this baseline, there were numerous changes in GHG emissions identified from the utility billing since the baseline year of 2000. These are consolidated and modeled in the analysis as the “End Use” entries in the table below.¹⁷ These add another 12,118 tons to the reduction goal. This information was also used to generate the emissions trend associated with projected city growth from 2009 to 2015. These projected additional GHG emissions are included in the calculations of each Plan. This adds 404 tons per year which is dependant on the projected population increase each year within the City.

Increases in Energy Consumption from 2000 to 2008			
End Use	kWh	Therms	Fuel (gals)
Bldg&Park Maint/Gen Proj Redev.	384,515	0	0
Fire Oper/Elect Oper Cntr/Bldg Maint	649,767	0	0
Police/Park Maint/Bldg Maint	773,498	0	0
Police/Diamond Oaks/Bldg Maint	966,913	0	0
Buildings	0	1,130,656	0
Water/Wastewater	9,705,644	0	0
Streetlights	1,589,684	0	0
Signals	-1,279,904	0	0
Fleet Additions	0	0	110,978
Commute	0	0	98,764
Totals	13,921,396	1,130,656	209,742
CO2e (metric tons)	3,819	6,329	1,970

Table 9: Increases in Energy Consumption from 2000 to 2008

The options for future action by the City are comprised of measures applicable to building and equipment energy efficiency, fuel efficiency, alternative fuel options, and distributed energy

¹⁶ 2006 and 2007 City of Roseville Greenhouse Gas Footprint Study, KEMA, March 2008, revised February 2009.

¹⁷ These End Uses represent 100% of the energy increases for all accounts as identified in the city's billing data. They are labeled as the accounts contributing most to the change.

generation. These options have been identified and quantified within this analysis. They are evaluated and presented as individual projects (measures), and as groups of measures (plans). Each is assigned a status (completed or future) and an implementation date to enable the calculation of cash flows over the life of the plans and the creation of energy cost trend graphs. The “palette” of measures includes emerging technologies which are in the pilot project stage of implementation. These are included on the assumption that they or an equivalent technology will be available by the year of implementation.¹⁸

The measures are grouped to create comprehensive GHG emissions reduction plans. Each of the plans is analyzed to provide profiles enabling the evaluation of the plans individually and in comparison to the other plan options.

Measure specific data such as capital cost, year of implementation, financing, energy and cost savings were processed to provide the following information for five action plans:

- Emissions reduction in tons CO2e avoided as a percentage of baseline
- CO2e reduction by sector
- Annual cash flow including debt service and incremental O&M costs
- Outstanding principal and debt service by year
- Simple Payback (SBP) for each plan
- Internal Rate of Return (IRR) for each plan
- Net Present Value (NPV) for each plan
- Avoided utility company payments (NPV over life of plan)
- Avoided fuel purchases (NPV over life of plan)
- Value invested locally in emission reduction projects

The details of each measure are provided in the Measure Details section beginning on page 48. The generally applied assumptions, such as the discount rate, interest rate, escalation rate for the cost of utility supplied power and fuel, and the CO2e conversion factors for energy and fuel have been reviewed by City Staff. The values used in the analysis are provided in Table 21 in the appendices. These general values can be overridden at the measure level if necessary. For example, the term of financing is set to 10 years as a default value. However, this length of financing is adjusted at the measure level where a 10 year term creates an excessively positive net cash flow for the measure.

Roseville Uses Alternative/Clean Fuels

Diesel Emissions Control Systems (DECS): Twenty-Three (23) solid waste collection trucks and nine (9) diesel transit buses have been retrofitted with DECS reducing the diesel particulate material (PM) by 85% and Nitrogen Oxides (Nox) by 25% for each vehicle.

Ultra Low Sulfur Diesel (ULSD): The City of Roseville

¹⁸ Example: A street lighting measure is included which relies on LED technology. There are several pilot projects underway that utilize this technology. However, if this specific strategy does not perform as anticipated (light pattern uniformity has been a concern), this analysis assumes another street lighting energy savings strategy of similar costs and benefits will be available by the implementation date of 2012.

Measure Identification

The list of measures has been generated from document reviews, past experience of other jurisdictions, and a review of the Roseville facilities completed by numerous energy professionals. All measures included in this analysis have been reviewed for inclusion by City Staff.

The following sources contributed to the information in this report.

- 2006 and 2007 City of Roseville Greenhouse Gas Footprint Study Final Report, KEMA, March 2008, revised February 2009.
- Energy Usage and Charges History, City of Roseville – 24 Months Usage, PGE, 12/11/2007.
- City of Roseville Electrical Energy Consumption, Green Team Study 2009, 1/15/2009.
- Energy and Water Management Report, 14 facility reports, Xenergy, March 9, 2001.
- City of Roseville Department of Transportation 2003 Employee Commute Information Survey, Aurora Research Group, July 2004.
- City of Roseville Department of Transportation 2006 Commuter Survey Research, Aurora Research Group, No date provided.
- Demographic, Development and Employment Profile 2007, Office of Economic Development, City of Roseville.
- Fleet Climate Action Data, City of Roseville, 1/12/2009.
- Roseville Electric 2005 Annual Report, Roseville Electric.
- Traffic Operations Project List, City of Roseville, March 2009.
- Engineering studies for various potential projects.
- Federal Stimulus Program Project Summaries, City of Roseville, April 2009.

Measure Assumptions: General Variables

This report is based on a set of general inputs for the financial analysis. Each measure utilizes these general inputs unless they are overridden at the measure level. The general inputs are provided in Table 21 on page 128 in the appendices. The values used for each measure are provided in the Appendices. These inputs include the following:

- Term of Analysis
- Term of Finance
- Discount Rate
- Energy Inflation Rate
- Energy Cost
- Interest Rate
- Inflation Rate

The lbs CO₂e per unit of energy conversions are based on the best available information. The values for natural gas, gasoline, and diesel fuel are consistent with the California Climate Action

Registry values with the following exceptions.¹⁹ The value for 100% ethanol is calculated using data from research published by Argonne Labs.²⁰ The value used for CO₂/kWh is based on the Roseville Electric fuel mix and is different than the value specified in the Registry.²¹ This value varies each year. This analysis uses the Power Content values provided in Table 10 which are based on information provided by Roseville Electric. The baseline value is 0.605 lbs/kWh derived from the values from 2000 to 2008. The full list of values is provided in the "General Inputs and Assumptions" table in the appendices.

The costs and benefits assumed for each of the measures is based on the best available information available at the time of research. Some measures have a highly reliable set of costs and energy reduction estimates due to the maturity of the strategy. Lighting retrofits fall into this category. Other measures rely on more vague data, such as the availability of LED street lighting and the associated costs. The dynamic context for electric and hybrid vehicles is another example of firm possibilities with unconfirmed costs and benefits. The implementation dates of such opportunities are pushed out to 2010, 2012 or later to balance the uncertainty of the cost benefit data. The inclusion of these less defined measures allows for a more complete set of plans and provides the framework for adjustments as more refined information becomes available.

Incremental Capital Cost of Efficiency Measures

Many of the opportunities to reduce energy consumption, and thereby reduce greenhouse gas emissions, involve the replacement of old, poorly performing equipment. In many cases this equipment is at the end of its useful life and is scheduled to be replaced independently of this analysis. In these situations this analysis may include only the incremental cost for exceeding the efficiency of a standard unit or approach. There are two common examples where this issue comes into play. The cost associated with replacing the package HVAC units is the additional cost incurred for purchasing SEER 15 units over the purchase of the standard SEER 13 units. This incremental cost depends on the cooling capacity of the unit, but is in the range of 3-10% of the cost of the unit. "Cool Roof" reflective coatings add an incremental cost of roughly \$1.5 per sq-ft to the overall reproofing project cost. This incremental value is utilized in the analyses utilizing this and similar measures. The cost assumed for the fleet replacement strategies are another example of the use of incremental capital cost.

It should be noted that many of the energy efficiency packages identified in these plans can be funded using California Performance Contracting and Power Purchase Agreements including the non-incremental costs. These packages are typically structured to have a net zero cash flow (energy savings = loan payment). The replacement of air conditioning equipment that is beyond its useful life would be one application of this opportunity.

Roseville Implements First Styrofoam Recycling Program in Northern California

In November 2007, the City of Roseville's Environmental Utilities Department launched a program to begin collecting and recycling Expanded Polystyrene (EPS), commonly known as Styrofoam. The program, a first for the region, provides EPS recycling bins at selected recycle drop-off sites throughout the city. The City is seeking to expand the program capacity and divert more material from being landfilled, and instead direct it towards beneficial reuse.

¹⁹ California Climate Action Registry General Reporting Protocol, Version 3.0, April 2008.

²⁰ Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions; M. Wang, C. Saricks, and D. D. Santini; Argonne Labs; January 1999.

²¹ See the "Roseville Electric Power Content" section within this Methodology Section.

Measure Specific Variables

The general inputs can be adjusted for each individual measure as appropriate. The other key individual inputs are listed below. The values for each measure are provided in the Appendices.

- Category (Building, Fleet, Commute, Distributed Generation, Water/Sewer)
- Status (Completed or Future).
- Financing: The cash flow is heavily dependent on whether or not the measures are financed. This funding decision is defined for each measure independently.
- Project Implementation Date
- Net Capital Cost
- Incremental Capital Cost associated with the cost premium associated with the improved efficiency. For Example: a plug-in hybrid compact vehicle is assigned a cost premium of \$8000 over an equivalent standard vehicle.
- Rebates and incentives
- Annual O&M cost associated with the efficiency measure
- Incremental Replacement Cost
- Component Life
- Time of Use factor (Photovoltaic systems)

Financial Analysis Results

The analysis provides the financial information required for investment decisions. This includes the following:

- Net Cash Flow for each year of the plans
- Debt load for each year of each plan
- Simple Payback for each plan
- Internal Rate of Return
- Net Present Value
- CO2e reduction for each plan

Financial Definitions²²

Simple Pay Back (SPB):

Simple pay back is determined by dividing the capital cost by the annual cost savings for an investment. While not effective in determining the value of the investment, it does provide the length of time before the initial investment is repaid. Given the various implementation dates for actions analyzed in each plan, the SPB for the plans is calculated by summing the net cost for each measure regardless of implementation date and comparing this value to the sum of the positive cash flows in subsequent years.

Net Present Value (NPV):

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield.

$$NPV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - C_0$$

²² <http://www.investopedia.com/terms>, <http://www.visitask.com>

Where

t - the time of the cash flow

n - the total time of the project

r - the discount rate

C_t - the net cash flow (the amount of cash) at time t .

C_0 - the capital outlay at the beginning of the investment time ($t = 0$)

Internal Rate of Return (IRR):

The Internal Rate of Return (IRR) is the discount rate that generates a zero net present value for a series of future cash flows. This essentially means that IRR is the rate of return that makes the sum of present value of future cash flows and the final market value of a project (or an investment) equal its current market value.

Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project. As such, IRR can be used to rank several prospective projects under consideration. Assuming all other factors are equal among the various projects, the project with the highest IRR would probably be considered the best and undertaken first.

The IRR is based on the total investment and energy cost savings over the life of the investment, independent of the financing strategy for the investment.²³

Financing Methods

There are four basic methods of project financing utilized in this analysis. The general terms for each are provided in Table 21 in the appendices. However specific terms for a measure may be defined at the measure level of the analysis. The funding methods are:

- 1) Standard financing at the interest rate and term defined at the general level or the measure specific level.
- 2) Power Purchase Agreement where the project is housed on city property and is owned by the vendor. The city agrees to purchase the power for the term of the contract.²⁴
- 3) Performance Contract where the vendor guarantees the savings of the measure for a specific payment financed over time. The term of the project (years of equivalent loan) is set to yield a net zero cash flow to the city.
- 4) Grant Funding assumes the net impact on the general fund for these projects is zero. The Federal Stimulus funded projects are assumed to receive 100% of the funding from this program. The transportation projects assume 70% of the funding is from an outside source (state and federal funding), and 30% from development impact fees.

Roseville's Cash for Grass Program Helps Homeowners Reduce Water Use

Roseville's Cash for Grass Rebate Program, the first in the region, helps property owners convert water-thirsty grass to a water efficient landscape. The City of Roseville rebates customers \$1.00 per square foot of grass removed and replaced with water efficient landscape with a \$1,000 cap per address. As of July 2009, there is a waiting list due to the number of residents desiring to participate in the program.

²³ The IRR and NPV for the Plans are calculated from the cash flows of the individual measures included in the respective plan, independent of the implementation date of each measure. This strategy results in a first year "investment" required for the IRR calculation and a subsequent annual cash flow (the return on investment).

²⁴ See PV projects utilizing the PPA option for more discussion of the assumed terms of power purchase agreements.

Community Benefit

The investments in the specific measures have positive local consequences. The community benefits are quantified and presented in the following outcomes:

- 1) **\$\$\$ Avoided Utility Company Payments**: This is the Net Present Value (NPV) of all the avoided electricity and natural gas payments over the 25 year period of the analysis.
- 2) **\$\$\$ Avoided Fuel Payments**: The NPV of the avoided gasoline and diesel fuel payments over the 25 year life of the analysis.
- 3) **\$\$\$ Invested Locally in GHG Projects**: This is the total capital cost of the measures specified for the plan. This analysis does not attempt to separate labor, material, overhead or profit to more accurately identify the percentage of these investments likely to remain local. The inherent overstatement of this result is balanced to a significant degree by discounting the well-documented economic multiplier effect of local investment (no multiplier is used). Biodiesel purchase is considered 100% local. In practice, this will depend on the supplier. Ethanol is not considered to be a local purchase.
- 4) **Jobs Created**: This is a simplified calculation using the methodology defined in the 2009 Federal Stimulus Package application procedures.

The formula is: \$1.0 Million in Capital Expenditure = 17 jobs created

This methodology does not incorporate timing of the expenditure or duration of the position.

Renewable Portfolio (RPS)

The Roseville Electric Renewable Portfolio Standard requires 20% renewable power resources in Roseville Electric's power portfolio. For over 20 years, the City of Roseville has used renewable energy resources to meet a portion of its customers' needs with its ownership participation in the Northern California Power Agency projects: Collierville hydroelectric facility (1990); geothermal facilities (1983 & 1985 or Plants 1 & 2, respectively); and its purchased power from the Federal entity Western Area Power Administration – Sierra Nevada Region Central Valley Project hydro-electric system. In addition, power is purchased from the landfill gas facility in Lincoln Landfill.

In 2008, these projects served approximately 25% of Roseville's electrical needs. When compared to conventional fossil fuel generation, the output from these renewable sources avoids the production of 215 million pounds of CO₂ which has the environmental impact of removing 18,000 cars from the road or planting more than 2.5 million trees each year.

Measure Evaluation

The decision to include a measure in the action plan is based on a comprehensive appraisal of that measure and its impact on the overall cost/benefits of the Action Plan. To aid in the selection process, each measure has been evaluated and scored for eight metrics listed below. While informative, the scoring of the measures is not binding on the selection process. The results of the Measure Evaluation are presented in the Plan Results section. A summary of the individual measure scoring is in the appendices.

- 1) Cost: The measure is scored by the magnitude of the net capital cost, independent of other considerations.
- 2) Financial Metrics: The measure is scored by the internal rate of return (IRR) and Net Present Value (NPV). IRR and NPV are determined from the investment required for the measure (Net Capital Cost), the annual cost savings and the resulting annual cash flow.
- 3) Resolution of Existing Problems: This metric evaluates how the measure solves existing problems, such as a failing air conditioning system. The replacement of old mechanical units will save maintenance staff time and associated costs.
- 4) GHG Impact: The measure is scored on its impact on the reduction of GHG emissions, relative to the other measures under consideration.
- 5) Public Visibility: Some measures provide an additional benefit by demonstrating to the general public the actions of the jurisdiction to address global warming. Measures such as Photovoltaic systems are scored high for Public Visibility.
- 6) Employee Impact: The additional burden or inconvenience imposed on City Staff is a consideration for any measure under consideration. A photovoltaic system has no impact and receives a neutral score. New fleet vehicles may require patience and scores lower. The Commute measure creates options for the City Staff and receives a higher score.
- 7) Community Impact: The additional benefit, burden or inconvenience imposed on the community is a consideration as well. This metric evaluates this impact. The improvement of public facilities, lighting or HVAC for example, would result in a favorable score. The imposition of additional fees or hardship on the community would result in an unfavorable score.
- 8) Energy Security: Energy cost variability is a concern for all jurisdictions. The price volatility of natural gas and the spike in cost for electricity in 2000-2001 give reason to address this vulnerability. This metric evaluates the impact by measure on the City's long term energy cost volatility. The highest value is assigned to energy efficiency measures. Energy saved by efficiency has an effective cost of \$0 into the future, as long as the efficiency measure is in place.
- 9) Job Creation: The creation of jobs as a result of local investment is calculated per the methodology discussed above.
- 10) Ease of Implementation: Measures have varying probabilities of gaining funding or public will for implementation. The scores assigned to each measure are highly subjective but ensure this important consideration is included in the evaluation of the overall emissions reduction plan.

California Low Carbon Fuel Standard

In the January 2007 State of the State, Governor Schwarzenegger asserted California's leadership in clean energy and environmental policy by establishing a Low-Carbon Fuel Standard (LCFS) by Executive Order. This first-in-the-world greenhouse gas (GHG) standard for transportation fuels will spark research in alternatives to oil and reduce GHG emissions.²⁵ The target GHG reduction is 10%. This analysis assumes this goal will be met over a 12 year period. This would reduce the carbon density for gasoline from 20.968 lbs CO2e/gallons to 18.871 lbs CO2e/gallon with a similar reduction for Diesel.

Roseville Electric Power Content

The sources of the energy purchased by the utility determine the carbon density (lbs CO2e per kWh) of the electricity produced by the utility and used by the City. This "Power Content" is identified by the utility and reported by the CPUC on an annual basis. There is a requirement that the power content include increasing percentages of renewable resources. The California Renewable Portfolio Standard (RPS) requires utilities to increase procurement from eligible renewable energy resources. As the power content carbon density decreases the emissions associated with electrical energy use decreases. Also as the carbon density decreases, the CO2e reductions per kWh displaced by photovoltaic and energy efficiency measures also decreases. Therefore a kWh saved in 2009 will save more CO2e than a kWh saved in 2015 if the Power Content is more "green" in 2015. This dynamic is factored into the analysis which is time dependent for both the implementation date of the measure and the reporting date for the emissions reduction. The power content values used in this analysis are provided in Table 10 below.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Power Content (lbs CO2e/kWh)	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Power Content (lbs CO2e/kWh)	0.495	0.622	0.486	0.520	0.604	0.660	0.573	0.730	0.753	0.768
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Power Content (lbs CO2e/kWh)	0.694	0.685	0.683	0.679	0.672	0.669	0.663	0.658	0.653	0.647
Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Power Content (lbs CO2e/kWh)	0.642	0.637	0.633	0.628	0.623	0.618	0.613	0.608	0.604	0.599
Year	2030	2031	2032	2033	2034	2035				
Power Content (lbs CO2e/kWh)	0.594	0.590	0.585	0.581	0.576	0.572				

Table 10: Power Content Values for Converting kWh to lbs/CO2e²⁶

²⁵ California Energy Commission, http://www.energy.ca.gov/low_carbon_fuel_standard, March 2009

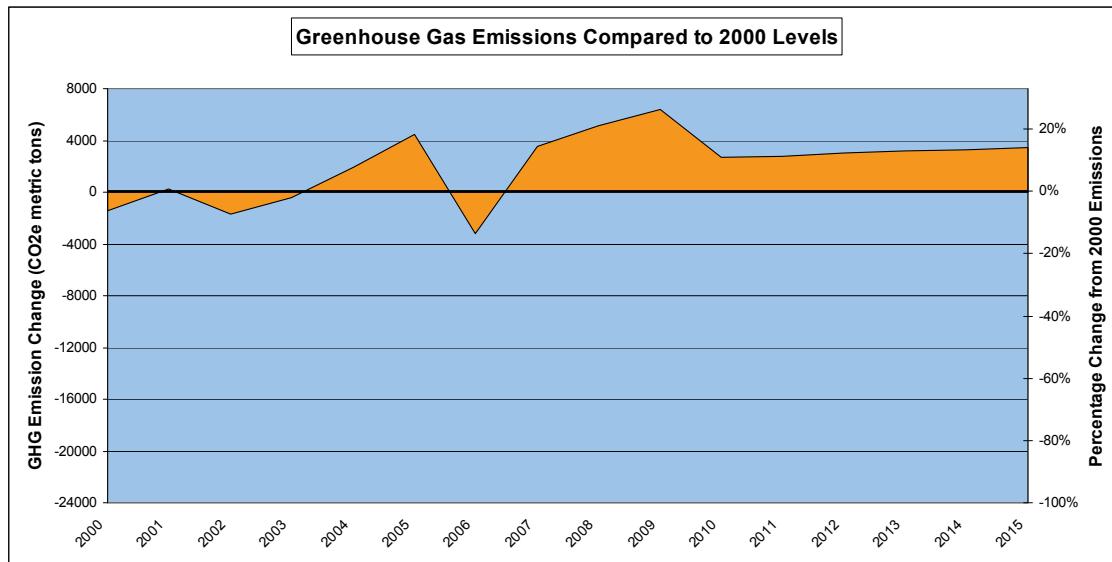
²⁶ The power content values for 2000 to 2017 were provided by Roseville Electric. The values prior to 2000 are based on the average value from 2000 to 2008. The values after 2017 are based on the constant average projected reduction from 2011 to 2017.

5.0 Plan Details

Plan A:	-3,484	Tons CO2e Avoided	-15.2%	% Reduction
Community Benefit (over 25 year life of plan)			Net Capital Cost	\$0
\$\$\$ Avoided Utility Company Payments	\$0		Jobs	0.0
\$\$\$ Avoided Fuel Purchases	\$0		IRR	0.0%
\$\$\$ Invested Locally in GHG Projects	\$0		NPV	\$0

Action Plan A: The City has the option of no future actions to reduce greenhouse gas emissions. This option would be a stark departure from the city's history of employing the best management practices available to reduce energy consumption. However, this plan is included to provide a reference point for the other four options. This no action plan includes the local carbon offsets of the completed traffic operational improvements (Measures 64 through 66)²⁷ and the completed PV and efficiency projects (Measures 69 through 78). Even with these emissions reducing actions, there is a net gain of almost 3,500 metric tons of Co2e, a 15% increase above 2000 levels. This increase is driven by the population gain and the associated expansion of city services, represented in Table 9, on page 28.

The figure below provides the emissions trend from 2000 to 2015. The trend reversals in years prior to 2006 are a result of the changing power content of the energy provided by Roseville Electric.²⁸ The significant decreases in 2006 and 2010 result from the reductions associated with the traffic improvement projects completed in 2005 and 2009.

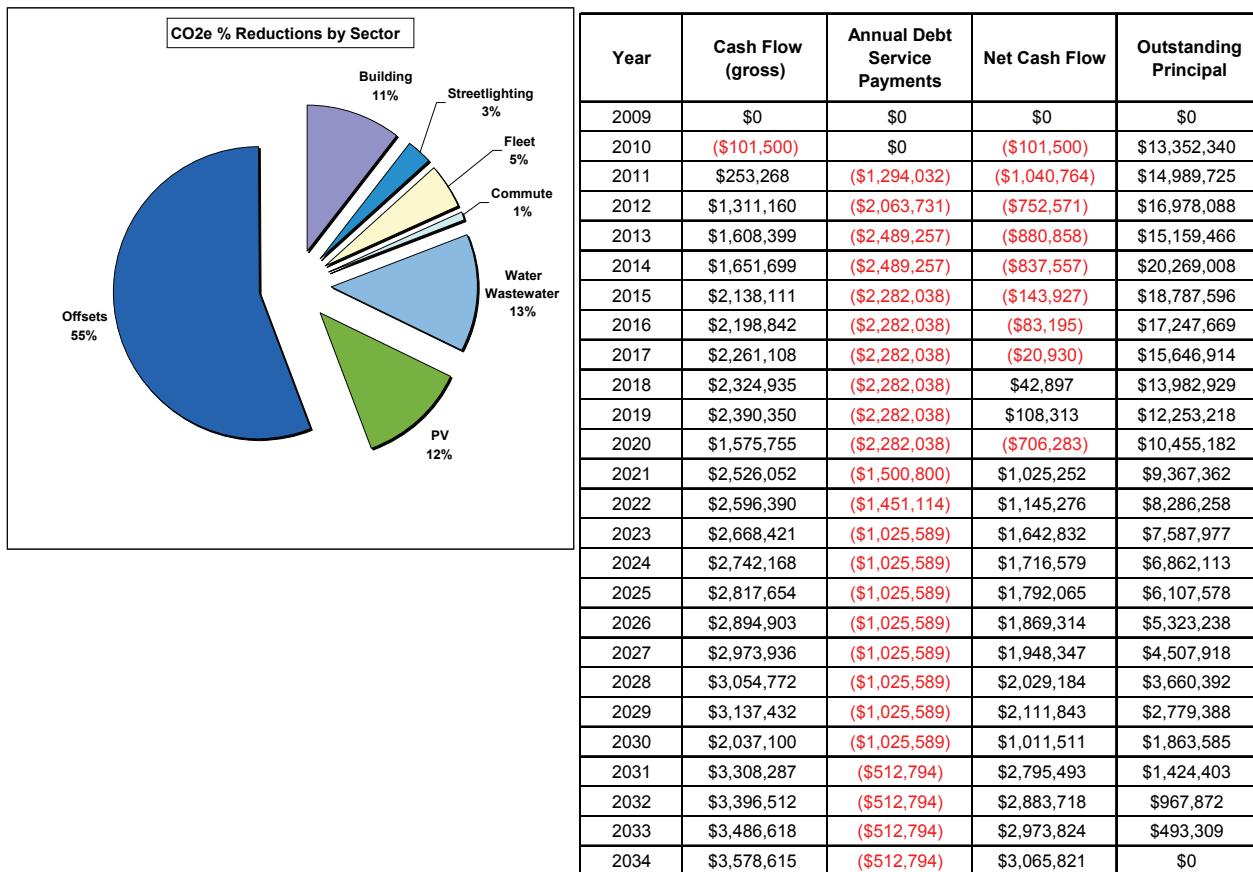


²⁷ The emissions reduction associated with the traffic operational improvements are included in all plans.

²⁸ The power content is dependant on the source energy used to generate the electricity provided to the city, expressed as lbs CO2e/kWh. The value is heavily dependant on the availability of hydroelectric energy and varies from 0.495 lbs/kWh in 2000 to 0.768 lbs/kWh in 2009.

Plan B: 4,541 Tons CO2e Avoided	19.8%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$26,817,840
\$\$\$ Avoided Utility Company Payments	Jobs	1,161.9
\$\$\$ Avoided Fuel Purchases	IRR	16.4%
\$\$\$ Invested Locally in GHG Projects	NPV	\$11,194,973

Action Plan B: The plan includes a combination of 18 new measures including eight Photovoltaic systems ranging from 160 kW to 4.7 MW utilizing both standard financing and power purchase agreement funding strategies. This plan also includes a broad range of energy and energy efficiency measures for the city buildings, fleet and wastewater system. The fleet measures are less aggressive including a range of plug in gasoline-electric hybrid sedans (PHEV) and hybrid truck vehicle replacements. This plan also includes the cogeneration projects proposed for the Pleasant Grove and Dry Creek wastewater treatment plants and the associated Grease to Gas methane generation project. Plan B provides for a net reduction of 20% below 2000 emissions levels (36.5% below 2006) with a reasonable internal rate of return of over 30%. Note: The debt payments in the later years for several plans are due to the co-generation and streetlighting measures which have a substantial initial capital cost and 20 year term of financing assumption.



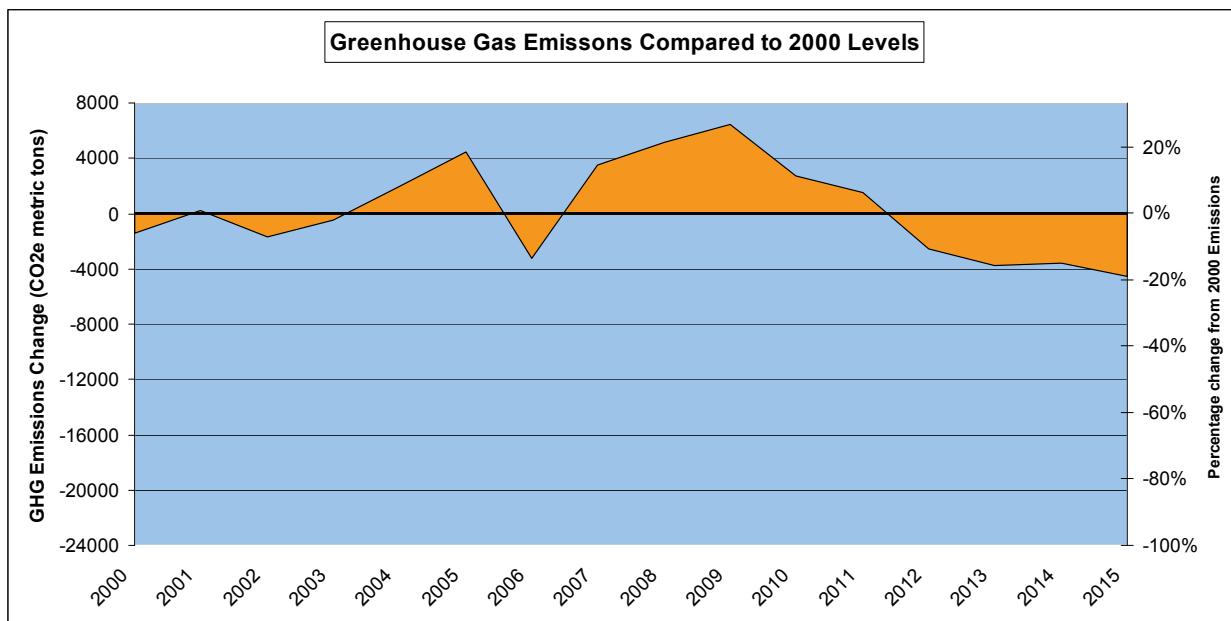


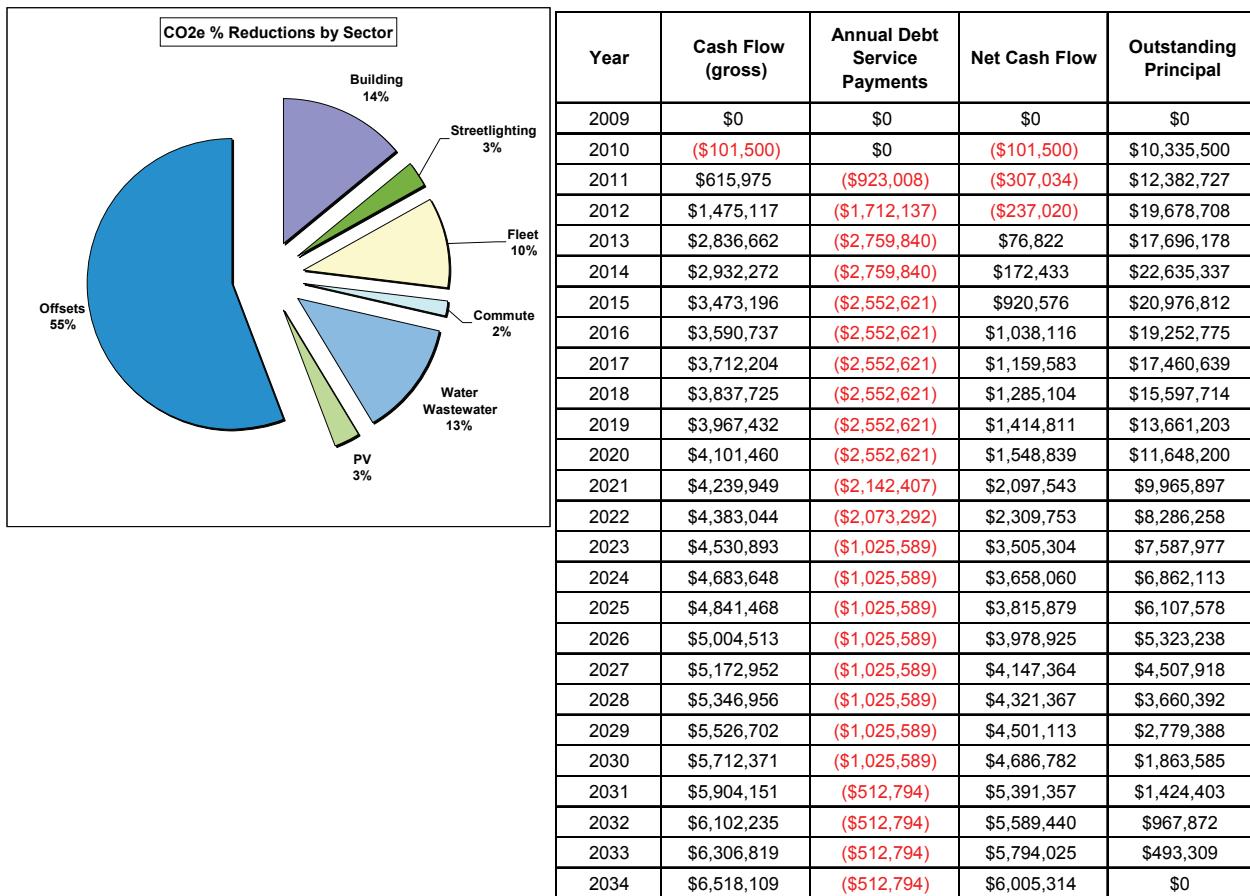
Figure 12: Plan B Emissions Reduction Trend 2000 - 2015²⁹

Plan B Measure List			Plan B Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2010	(\$101,500)
3	City Facilities Energy Efficiency (City funded)	2011	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	2011	(\$1,040,764)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2012	(\$752,571)
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2013	(\$880,858)
14	Co Gen Linked to Dry Creek Grease to Gas	2012	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2014	(\$837,557)
18	Fleet Replacement Strategy A	2011				2015	(\$143,927)
24	Biodiesel 20% linked to Fleet A	2010				2016	(\$83,195)
30	Commute Program Enhancement A	2010				2017	(\$20,930)
35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	2010				2018	\$42,897
36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011				2019	\$108,313
37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	2010				2020	(\$706,283)
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012				2021	\$1,025,252
41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010				2022	\$1,145,276
						2023	\$1,642,832
						2024	\$1,716,579
						2025	\$1,792,065

²⁹ Reductions include utility Power Content changes over time and the impact of the CA Low Carbon Fuel Standard

Plan C: 5,237 Tons CO2e Avoided	22.8%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$28,967,983
\$\$\$ Avoided Utility Company Payments	Jobs	669.9
\$\$\$ Avoided Fuel Purchases	IRR	80.1%
\$\$\$ Invested Locally in GHG Projects	NPV	\$35,187,890

Action Plan C: This plan includes 19 measures and improves the investment results by replacing four of the photovoltaic projects with the parks water efficiency project funded by the city and a much more aggressive fleet and transit bus replacement strategy. This plan also employs a street lighting energy reduction measure. Plan C exceeds the reductions of Plan B, achieving a projected 23% GHG emissions reduction by 2015 with very attractive financial metrics, and over \$33 Million invested locally over the life of the plan. The Internal Rate of Return is over 150% and the Net Present Value exceeds \$40 million over the term of the analysis (25 years). The annual net cash flow (energy cost savings minus project debt service, replacement costs and associated O&M) is negative for a number of years then turns strongly positive in 2013. The use of power purchase agreements for the photovoltaic projects improves the cost / benefits results for this comprehensive strategy.



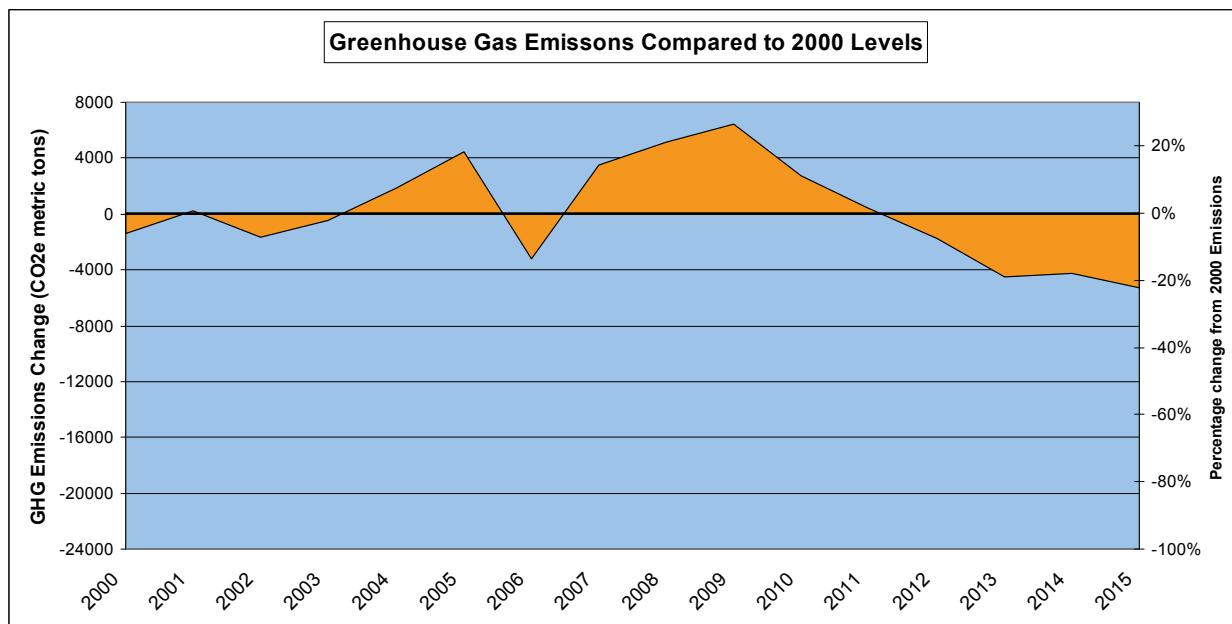
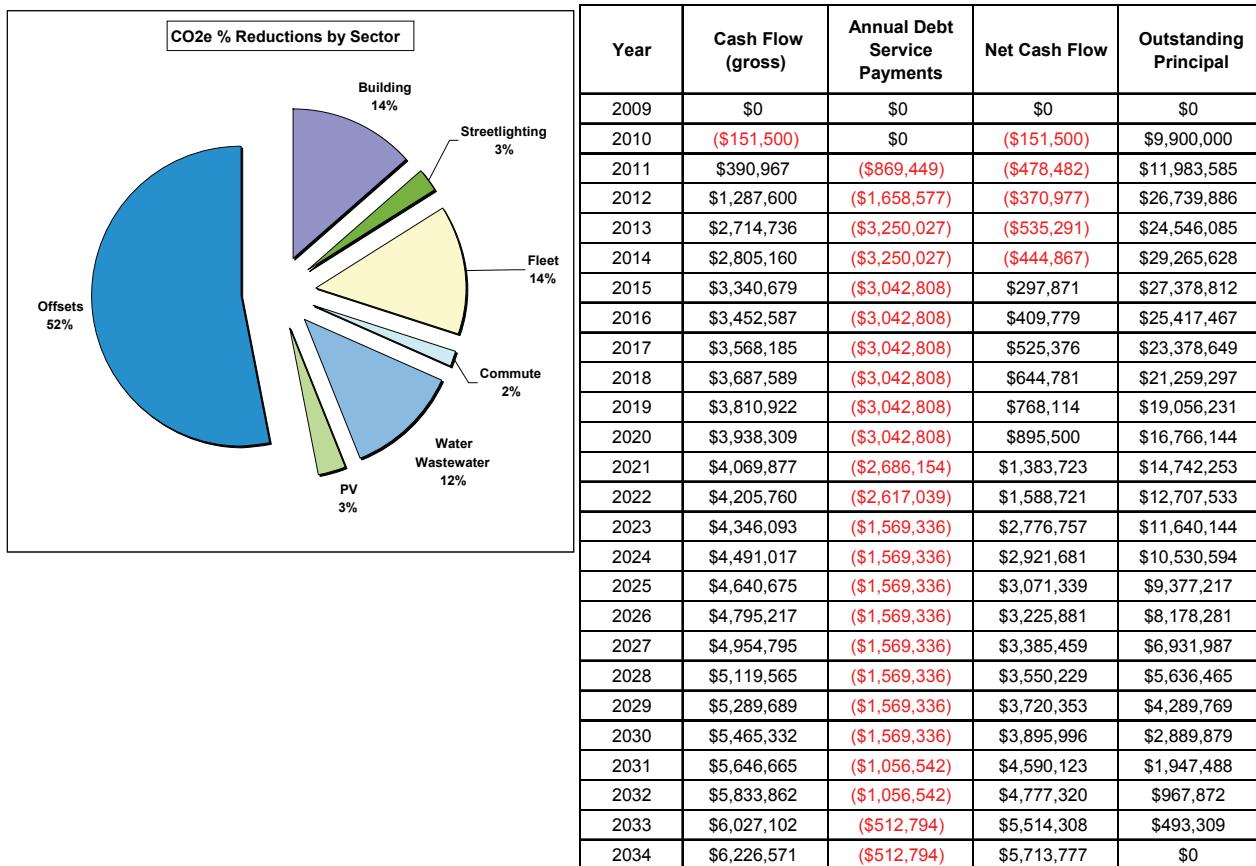


Figure 13: Plan C Emissions Reduction Trend 2000 – 2015

Plan C Measure List			Plan C Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2010	(\$101,500)
3	City Facilities Energy Efficiency (City funded)	2011	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2011	(\$307,034)
8	Streetlighting Reduce Residential Lumins (50%)	2010	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2012	(\$237,020)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	2013	\$76,822
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	64	Traffic Operational Improvements '04-'05 (Offset)	2005	2014	\$172,433
14	Co Gen Linked to Dry Creek Grease to Gas	2012	65	Traffic Operational Improvements '06-'07 (Offset)	2007	2015	\$920,576
16	Transit Bus Replacement Strategy B	2011	66	Traffic Operational Improvements '08-'09 (Offset)	2009	2016	\$1,038,116
17	Fleet Management Software Eff. Initiatives	2010				2017	\$1,159,583
19	Fleet Replacement Strategy B	2012				2018	\$1,285,104
25	Biodiesel 20% Linked to Fleet B	2010				2019	\$1,414,811
30	Commute Program Enhancement A	2010				2020	\$1,548,839
31	Commute Program Enhancement B	2011				2021	\$2,097,543
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012				2022	\$2,309,753
						2023	\$3,505,304
						2024	\$3,658,060
						2025	\$3,815,879

Plan D: 6,105 Tons CO2 Avoided	26.6%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$36,055,010
\$\$\$ Avoided Utility Company Payments	Jobs	1,178.1
\$\$\$ Avoided Fuel Purchases	IRR	31.6%
\$\$\$ Invested Locally in GHG Projects	NPV	\$26,762,975

Action Plan D: The plan includes a combination of 22 measures plus the three completed traffic operational improvements included in all plans. This plan pushes the GHG reduction to 27% below 2000 levels (42% below 2006) by including an aggressive street lighting strategy converting 80% of the fixtures to newly available LED technology. It also includes use of 99% biodiesel fuel for all vehicles other than public safety, as well as the aggressive fleet replacement strategy B and the parks water efficiency upgrade project. The cash flow includes the staff time of a full time “efficiency coordinator” calculated at \$60k (1 FTE) to support the implementation of this comprehensive set of energy and energy efficiency projects. The cash flow assumes city funding for all but one of the projects.



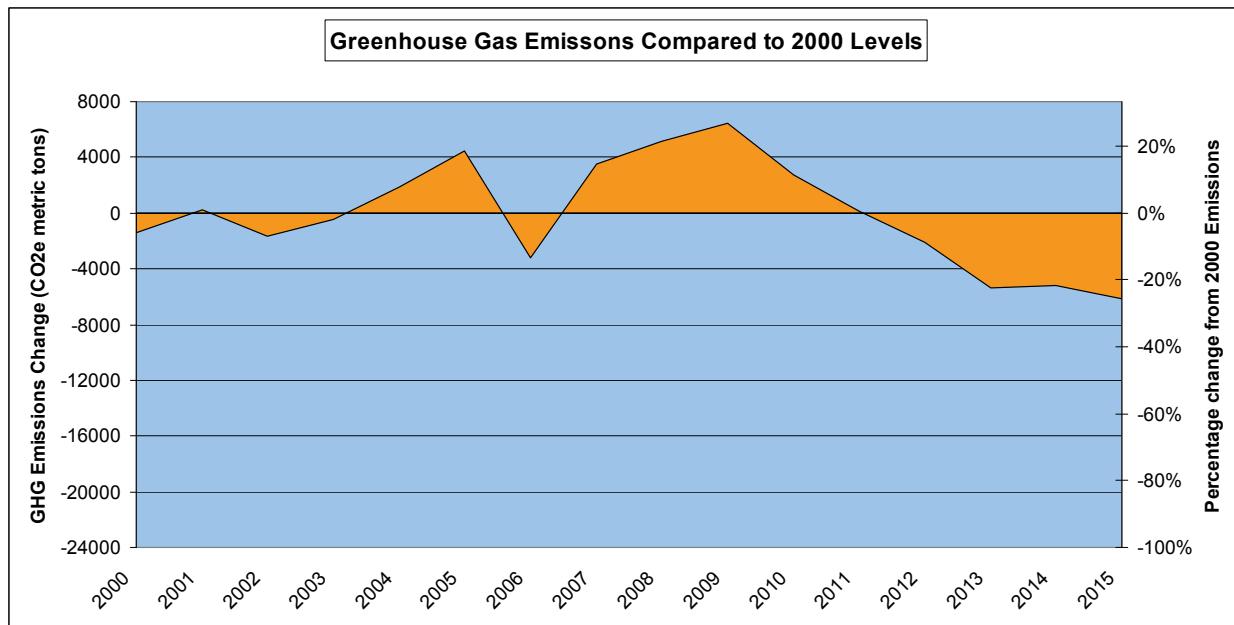
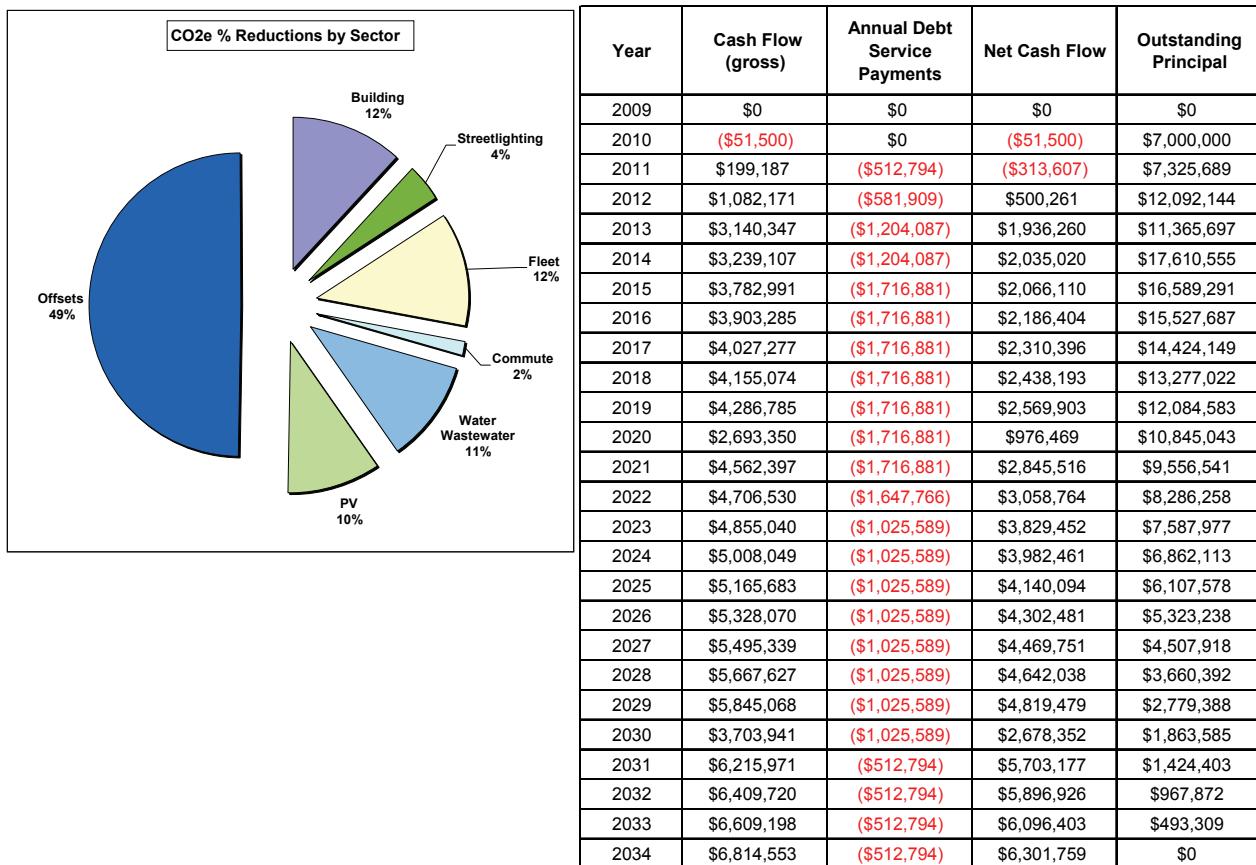


Figure 14: Plan D Emissions Reduction Trend 2000 - 2015

Plan D Measure List			Plan D Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	33	Staff Efficiency Coordinator	2010	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	2010	(\$151,500)
3	City Facilities Energy Efficiency (City funded)	2011	39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012	2011	(\$478,482)
6	Streetlighting HID to LED 40% Fixtures	2012	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	2012	(\$370,977)
7	Streetlighting HID to LED 40% Fixtures	2012	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	2013	(\$535,291)
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	2014	(\$444,867)
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2015	\$297,871
14	Co Gen Linked to Dry Creek Grease to Gas	2012	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	2016	\$409,779
16	Transit Bus Replacement Strategy B	2011	64	Traffic Operational Improvements '04- '05 (Offset)	2005	2017	\$525,376
17	Fleet Management Software Eff. Initiatives	2010	65	Traffic Operational Improvements '06- '07 (Offset)	2007	2018	\$644,781
19	Fleet Replacement Strategy B	2012	66	Traffic Operational Improvements '08- '09 (Offset)	2009	2019	\$768,114
29	Biodiesel 99% Linked to Fleet B	2010				2020	\$895,500
30	Commute Program Enhancement A	2010				2021	\$1,383,723
31	Commute Program Enhancement B	2011				2022	\$1,588,721
						2023	\$2,776,757
						2024	\$2,921,681
						2025	\$3,071,339

Plan E: 8,895 Tons CO2e Avoided	38.7%	% Reduction
<u>Community Benefit (over 25 year life of plan)</u>	Net Capital Cost	\$73,082,596
\$\$\$ Avoided Utility Company Payments	Jobs	1,850.0
\$\$\$ Avoided Fuel Purchases	IRR	912.5%
\$\$\$ Invested Locally in GHG Projects	NPV	\$46,321,399

Action Plan E: This plan includes 26 new measures including two future traffic operational improvement measures. In addition to most of the measures of Plan D, Plan E includes an Energy Engineer position and an additional large photovoltaic system. Contrary to Plan D, this strategy assumes Federal Stimulus Program funding for many of the projects which greatly improves the investment results. This best case scenario results in almost \$100 million invested locally in greenhouse gas emissions reduction projects over the life of the plan.



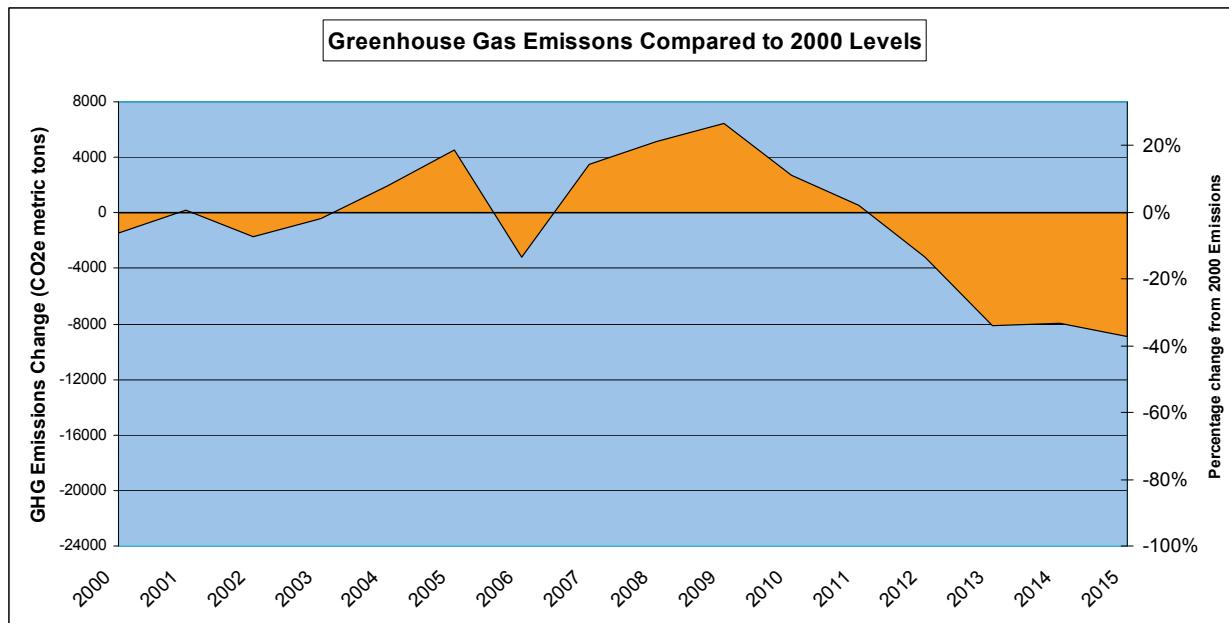


Figure 15: Plan E Emissions Reduction Trend 2000 - 2015

Plan E Measure List			Plan E Measure List			Year	Annual Net Cash Flow
No.	Measure Name	Impl. Date	No.	Measure Name	Impl. Date		
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	2009	\$0
2	Building Solar Thermal (PPA funded)	2010	38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	2010	2010	(\$51,500)
4	City Facilities Energy Efficiency (Federal Stimulus funded)	2011	40	PV 160 kW DC (Fixed Tilt) Downtown Parking (Stimulus Funded)	2010	2011	(\$313,607)
5	Streetlighting HID to LED (Federal Stimulus Funded)	2012	42	PV 230 kW DC (Fixed Tilt)- Mahany Pk Parking Area (Stimulus Funded)	2010	2012	\$500,261
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking (Stimulus Funded)	2010	2013	\$1,936,260
13	Grease to Gas Dry Creek WWTP (requires CoGen) (Grant Funded)	2012	46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	2010	2014	\$2,035,020
14	Co Gen Linked to Dry Creek Grease to Gas	2012	49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2012	2015	\$2,066,110
16	Transit Bus Replacement Strategy B	2011	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	2016	\$2,186,404
17	Fleet Management Software Eff. Initiatives	2010	60	Water Efficiency Upgrade Project- retrofit of parks (Stimulus funded)	2012	2017	\$2,310,396
19	Fleet Replacement Strategy B	2012	64	Traffic Operational Improvements '04- '05 (Offset)	2005	2018	\$2,438,193
29	Biodiesel 99% Linked to Fleet B	2010	65	Traffic Operational Improvements '06- '07 (Offset)	2007	2019	\$2,569,903
30	Commute Program Enhancement A	2010	66	Traffic Operational Improvements '08- '09 (Offset)	2009	2020	\$976,469
31	Commute Program Enhancement B	2011	67	Traffic Operational Improvements '10- '12 (Offset)	2012	2021	\$2,845,516
32	Staff Efficiency Engineer	2010	68	Traffic Operational Improvements '13- '15 (Offset)	2014	2022	\$3,058,764
33	Staff Efficiency Coordinator	2010				2023	\$3,829,452
						2024	\$3,982,461
						2025	\$4,140,094

Action Plan Evaluations

The GHG Emission Reduction Action Plans involve more than CO2e reduction and cash flow. There are critical concerns that should be factored into the decision making process. These include the financial metrics of internal rate of return (IRR) and net present value (NPV) used to evaluate the worthiness of the investment; the cost of implementing the measure, some measures come with a large price tag which will challenge liquidity; the degree to which the plan resolves existing problems, such as replacing old, high maintenance air conditioning units; and the visibility of the measures to the public, for example the photovoltaic systems are a physical example of actions taken the City and communicate action and commitment to the community. Other key considerations include the employee impacts of new equipment or procedures, which may generate internal opposition; and the reduction of vulnerability to future energy costs.

Each measure and the plans as a whole are evaluated by the following considerations:

- Measure Capital Cost:
- Financial Metrics (IRR and NPV)
- Resolution of Existing Problems
- GHG Impact
- Positive Public Visibility
- Employee Impact
- Community Impact
- Energy Security (Energy Cost Stabilization)
- Job Creation
- Ease and Probability of Implementation

The “adjusted measure score” reflects the relative weighting of the evaluation criteria as presented in Table 11 below.

Cost (relative) -3 to 3	Financial Metrics (relative)	Resolution of Problems (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Security (cumulative)	Job Creation (Cumulative)	Ease of Implementation (relative)	total=30
1	5	1	3	5	3	3	5	1	3	30

Table 11: Evaluation Criteria Weighting³⁰

The scoring for the plans is derived from the evaluations of each measure included in the plan. Each of the measures received a score for each of the criteria listed above. These measure level evaluations are provided in the appendices.

³⁰ total allocation = 3 x number of criteria = 3 x 10 = 30, average score = 3

The table below compiles the scoring for each measure included in each plan and yields a relative score for each metric. As with the previous table, a higher score indicate more a more favorable evaluation for that metric or plan. Plan D, for example scores high on “Public Visibility” but scores lowest on “Financial Metrics” and scores below Plans D and E overall. The category weighting has been integrated into these numbers as well as an integration factor to allow the aggregation of the relative and comprehensive values.³¹

Evaluation Scoring					
Metric \ Plan	A	B	C	D	E
Cost	0.0	28.9	29.8	30.3	61.4
Financial Metrics	0.0	-85.6	-45.8	-112.4	34.4
Resolution of Existing Problems	0.0	1.6	2.6	3.3	4.8
GHG Impact	8.6	28.2	31.0	32.5	39.8
Public Visibility	0.0	58.2	52.6	61.4	68.6
Employee Impact	0.0	1.4	2.9	4.8	4.3
Community Impact	0.0	9.0	4.5	9.0	27.0
Energy Security	0.0	20.6	22.5	22.6	30.3
Job Creation	0.0	3.6	2.7	4.8	6.5
Ease of Implementation	0.0	81.0	99.0	96.0	90.0
Total	8.6	146.9	201.8	152.4	367.0

Table 12: Plan Evaluation Results

This analysis is intended to provide an overview of the effectiveness of each plan as a whole and by each evaluation criteria. While it should encourage a more comprehensive review of the cost/benefits of each strategy, these quantitative results are based on subjective judgments and are advisory only. While informative, they are only one of many considerations in the selection of the most appropriate plan for the City of Roseville.

³¹ Calculation note: A factor of 0.16 was applied to the results of the “cumulative” metrics to equalize the scale of results for the two types of scoring (relative and cumulative).

6.0 Measure Details

The tables below provide the financial results for the measures considering in this analysis.

No.	Measure Name	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Annual CO2 Reduction (tons)	Financing	Internal Rate of Return	Net Present Value
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	\$300,000	\$5,356	\$0	28	Grant	na	\$106,341
2	Building Solar Thermal (PPA funded)	2010	\$0	(\$14,917)	\$0	82	PPA	64.8%	(\$141,566)
3	City Facilities Energy Efficiency (City funded)	2011	\$2,000,000	\$768,231	\$0	2021	Perform Contract	NA	\$13,347,745
4	City Facilities Energy Efficiency (Federal Stimulus funded)	2011	\$2,000,000	\$768,231	\$0	2021	Grant	NA	\$15,252,507
5	Streetlighting HID to LED (Federal Stimulus Funded)	2012	\$10,030,000	\$368,079	(\$30,756)	933	Grant	NA	\$7,918,500
6	Streetlighting HID to LED 40% Fixtures	2012	\$3,711,264	\$22,982	(\$12,303)	266	Perform Contract	0.0%	(\$2,833,995)
7	Streetlighting HID to LED 40% Fixtures	2012	\$3,711,264	\$22,982	(\$12,303)	266	Perform Contract	0.0%	(\$2,833,995)
8	Streetlighting Reduce Residential Lumens (50%)	2010	\$435,500	\$59,197	\$0	747	City Financed	16.9%	\$760,542
9	Streetlighting Residential Darken 2nd 50% of Fixtures	2010	\$217,750	\$59,197	\$15,378	747	no	24.1%	\$662,604
10	Streetlighting Residential Darken 1st 50% of Fixtures	2010	\$217,750	\$59,197	(\$15,378)	747	no	38.9%	\$1,273,241
11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	\$7,000,000	\$520,394	\$93,208	1211	Perform Contract	7.2%	\$1,814,710
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	2012	\$3,460,000	\$0	(\$206,680)	0	City Financed	7.0%	\$808,202
13	Grease to Gas Dry Creek WWTP (requires CoGen) (Grant Funded)	2012	\$3,460,000	\$0	(\$206,680)	0	Grant	0.0%	\$4,103,440
14	Co Gen Linked to Dry Creek Grease to Gas	2012	\$7,000,000	\$542,405	\$226,193	1348	Perform Contract	4.5%	(\$388,573)
15	Transit Bus Replacement Strategy A	2011	\$350,763	\$247,821	\$0	123	City Financed	76.6%	\$4,586,193
16	Transit Bus Replacement Strategy B	2011	\$561,983	\$128,494	\$0	162	City Financed	27.0%	\$2,015,911
17	Fleet Management Software Eff. Initiatives	2010	\$0	\$65,201	\$3,570	172	no	0.0%	\$1,223,629
18	Fleet Replacement Strategy A	2011	\$404,000	\$215,959	\$0	523	City Financed	58.8%	\$3,902,899
19	Fleet Replacement Strategy B	2012	\$5,059,000	\$967,671	\$0	1562	City Financed	23.0%	\$14,394,115
20	Biodiesel 5%	2010	\$0	(\$6,077)	\$0	121	no	NA	(\$120,662)
21	Biodiesel 20%	2010	\$1,500	(\$24,310)	\$0	483	no	NA	(\$484,077)
22	Biodiesel 50%	2010	\$51,500	(\$60,775)	\$0	1207	no	NA	(\$1,255,670)
23	Biodiesel 99%	2010	\$51,500	(\$120,334)	\$0	2389	no	NA	(\$2,438,160)

Table 13: Results by Measure (1-23)

No.	Measure Name	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Annual CO2 Reduction (tons)	Financing	Internal Rate of Return	Net Present Value
24	Biodiesel 20% linked to Fleet A	2010	\$1,500	(\$24,310)	\$0	483	no	NA	(\$484,077)
25	Biodiesel 20% Linked to Fleet B	2010	\$1,500	(\$12,631)	\$0	251	no	NA	(\$252,205)
26	Biodiesel 50% linked to Fleet A	2010	\$51,500	(\$60,775)	\$0	1207	no	NA	(\$1,255,670)
27	Biodiesel 50% Linked to Fleet B	2010	\$51,500	(\$31,577)	\$0	627	no	NA	(\$675,989)
28	Biodiesel 99% Linked to Fleet A	2010	\$51,500	(\$60,775)	\$0	1207	no	NA	(\$1,255,670)
29	Biodiesel 99% Linked to Fleet B	2010	\$51,500	(\$62,523)	\$0	1241	no	NA	(\$1,290,391)
30	Commute Program Enhancement A	2010	\$0	\$0	\$35,000	125	no	NA	(\$694,893)
31	Commute Program Enhancement B	2011	\$0	\$0	\$35,000	125	no	NA	(\$694,893)
32	Staff Efficiency Engineer	2010	\$0	\$0	\$100,000	0	no	NA	(\$1,985,407)
33	Staff Efficiency Coordinator	2010	\$0	\$0	\$60,000	0	no	NA	(\$1,191,244)
34	PV 500 kW DC (unspecified location) PPA	2010	\$0	(\$30,213)	\$0	164	PPA	NA	(\$326,517)
35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	2010	\$1,945,403	\$41,109	\$4,859	113	City Financed	NA	(\$1,410,651)
36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	\$50,000	(\$29,046)	\$0	156	PPA	NA	(\$361,533)
37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	2010	\$4,426,937	\$147,304	\$11,063	225	City Financed	NA	(\$2,155,319)
38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	2010	\$4,426,937	\$81,383	\$11,063	225	Grant	NA	\$742,495
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012	\$50,000	(\$9,668)	\$0	52	PPA	NA	(\$152,105)
40	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area (Stimulus Funded)	2010	\$1,038,315	\$19,065	\$2,592	53	Grant	NA	\$173,937
41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	\$50,000	(\$13,898)	\$0	76	PPA	NA	(\$197,817)
42	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area (Stimulus Funded)	2010	\$1,491,859	\$27,406	\$3,726	76	Grant	NA	\$250,035
43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	\$50,000	(\$18,430)	\$0	99	PPA	NA	(\$246,794)
44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area (Stimulus Funded)	2010	\$1,977,799	\$36,343	\$4,940	100	Grant	NA	\$331,568
45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	\$50,000	(\$33,234)	\$0	181	PPA	NA	(\$406,788)
46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	2010	\$3,565,203	\$65,536	\$8,909	181	Grant	NA	\$597,910

Table 14: Results by Measure (24-46)

GHG Reduction Action Plan Analysis

No.	Measure Name	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Annual CO2 Reduction (tons)	Financing	Internal Rate of Return	Net Present Value
47	PV 1.0 MW DC (Single Axis)-Roseville Energy Park (Stimulus funded)	2010	\$6,480,843	\$137,029	\$16,198	378	Grant	NA	\$1,441,968
48	PV 1.74 MW DC (Fixed Tilt)-Brownfield Site (Stimulus funded)	2010	\$11,275,451	\$207,331	\$28,185	572	Grant	NA	\$1,891,569
49	PV 320 kW DC (Fixed Tilt) Energy Source for Electric Vehicles (New Fleet B) PPA	2012	\$50,000	(\$19,336)	\$0	104	PPA	NA	(\$256,590)
50	PV (4.7 MW DC Fixed Tilt) PPA	2011	\$50,000	(\$283,999)	\$0	1525	PPA	NA	(\$3,116,880)
51	Energy Efficient Appliance Rebate Program (local offset)	2012	\$500,000	\$0	\$0	300	Grant	NA	\$0
52	HVAC Maintenance Energy Efficiently Program (local offset)	2012	\$900,000	\$0	\$0	86	Grant	NA	\$0
53	Non-Residential On-site audits (local offset)	2012	\$600,000	\$0	\$0	1709	Grant	NA	\$0
54	Residential and Commercial Energy Efficiency and Solar Loan funding (local offset)	2014	\$10,000,000	\$0	\$0	7967	Grant	NA	\$0
55	Residential Duct Testing and Sealing (local offset)	2013	\$7,500,000	\$0	\$0	85	Grant	NA	\$0
56	Residential New Construction M&V Programs (local offset)	2013	\$3,750,000	\$0	\$0	670	Grant	NA	\$0
57	Residential On-site audit and energy efficiency upgrades program (local offset)	2014	\$5,000,000	\$0	\$0	850	Grant	NA	\$0
58	Residential Solar Electric Generation programs (local offset)	2012	\$7,200,000	\$0	\$0	731	Grant	NA	\$0
59	Weatherization Assistance (local offset)	2011	\$6,750,000	\$0	\$0	808	Grant	NA	\$0
60	Water Efficiency Upgrade Project retrofit of parks (Stimulus funded)	2012	\$2,900,000	\$342,696	\$0	768	Grant	NA	\$6,803,908
61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	\$2,900,000	\$293,806	\$0	768	City Financed	12.8%	\$3,071,349
62	Direct Load Control Project (local offset)	2014	\$3,000,000	\$0	\$0	409	Grant	NA	\$0
63	Business Solar Energy Installation (local offset)	2010	\$2,500,000	\$0	\$0	757	Grant	NA	\$0
64	Traffic Operational Improvements '04-'05 (Offset)	2005	\$40,750,000	\$0	\$0	6747	no	NA	\$0
65	Traffic Operational Improvements '06-'07 (Offset)	2007	\$1,074,727	\$0	\$0	1609	no	NA	\$0
66	Traffic Operational Improvements '08-'09 (Offset)	2009	\$10,156,225	\$0	\$0	2615	no	NA	\$0
67	Traffic Operational Improvements '10-'12 (Offset)	2012	\$16,320,000	\$0	\$0	658	Grant	NA	\$0
68	Traffic Operational Improvements '13-'15 (Offset)	2014	\$5,800,000	\$0	\$0	37	Grant	NA	\$0

Table 15: Results by Measure (47 – 68)

Measure Selection

Each Plan is comprised of measures from the tables above. The makeup of each plan is provided in the table below. A "y" in the column under the Action Plan (A –E) in the first five columns indicates that the measure is included in that plan. Action Plan A contains no new measures. Action Plan C includes 22 measures including three local carbon offsets. Action Plan E has 29 individual measures including 5 traffic operational improvements analyzed as local carbon offsets. Three of these are completed.

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	y	y	y	y	1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	2010	no	yes
n	y	y	y	y	2	Building Solar Thermal (PPA Funded)	2010	no	no
n	y	y	y	n	3	City Facilities Energy Efficiency (City Funded)	2011	yes	no
n	n	n	n	y	4	City Facilities Energy Efficiency (Federal Stimulus Funded)	2011	no	yes
n	n	n	n	y	5	Streetlighting HID to LED (Federal Stimulus Funded)	2012	no	yes
n	n	n	y	n	6	Streetlighting HID to LED 40% Fixtures	2012	yes	no
n	n	n	y	n	7	Streetlighting HID to LED 40% Fixtures	2012	yes	no
n	n	y	n	n	8	Streetlighting Reduce Residential Lumens 50%	2010	yes	no
n	n	n	n	n	9	Streetlighting Residential Darken First 50% of Fixtures	2010	no	no
n	n	n	n	n	10	Streetlighting Residential Darken Second 50% of Fixtures	2010	no	no
n	y	y	y	y	11	Pleasant Grove WWTP CoGen (540 kW Engine)	2014	yes	no
n	y	y	y	n	12	Grease to Gas Dry Creek WWTP partnered with CoGen (City Funded)	2012	yes	no
n	n	n	n	y	13	Grease to Gas Dry Creek WWTP partnered with CoGen (Grant Funded)	2012	no	yes
n	y	y	y	y	14	Co Gen Linked to Dry Creek Grease to Gas	2012	yes	no

Table 16: Measures 1 - 14

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	15	Transit Bus Replacement Strategy A	2011	yes	no
n	n	y	y	y	16	Transit Bus Replacement Strategy B	2011	yes	no
n	n	y	y	y	17	Fleet Management Software Efficiency Initiatives	2010	no	no
n	y	n	n	n	18	Fleet Replacement Strategy A	2011	yes	no
n	n	y	y	y	19	Fleet Replacement Strategy B	2012	yes	no
n	n	n	n	n	20	Biodiesel 5%	2010	no	no
n	n	n	n	n	21	Biodiesel 20%	2010	no	no
n	n	n	n	n	22	Biodiesel 50%	2010	no	no
n	n	n	n	n	23	Biodiesel 99%	2010	no	no
n	y	n	n	n	24	Biodiesel 20% linked to Fleet A	2010	no	no
n	n	y	n	n	25	Biodiesel 20% Linked to Fleet B	2010	no	no
n	n	n	n	n	26	Biodiesel 50% linked to Fleet A	2010	no	no
n	n	n	n	n	27	Biodiesel 50% Linked to Fleet B	2010	no	no
n	n	n	n	n	28	Biodiesel 99% Linked to Fleet A	2010	no	no
n	n	n	y	y	29	Biodiesel 99% Linked to Fleet B	2010	no	no
n	y	y	y	y	30	Commute Program Enhancement A	2010	no	no
n	n	y	y	y	31	Commute Program Enhancement B	2011	no	no
n	n	n	n	y	32	Staff Efficiency Engineer	2010	no	no
n	n	n	y	y	33	Staff Efficiency Coordinator	2010	no	no

Table 17: Measures 15 – 33

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	34	PV 500 kW DC PPA (unspecified location)	2010	no	no
n	y	n	n	n	35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	2010	yes	no
n	y	n	y	y	36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2011	no	no
n	y	n	n	n	37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	2010	yes	no
n	n	n	n	y	38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	2010	no	yes
n	y	y	y	n	39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2012	no	no
n	n	n	n	y	40	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2010	no	no
n	n	n	n	y	42	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2011	no	no
n	n	n	n	y	44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area (Stimulus Funded)	2010	no	yes
n	y	y	y	n	45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2010	no	no
n	n	n	n	y	46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	2010	no	yes
n	n	n	n	n	47	PV 1.0 MW DC (Single Axis)- Roseville Energy Park (Stimulus funded)	2010	no	yes
n	n	n	n	n	48	PV 1.74 MW DC (Fixed Tilt)- Brownfield Site (Stimulus funded)	2010	no	yes
n	n	y	y	y	49	PV 320 kW DC (Fixed Tilt) Energy Source for Electric Vehicles (New Fleet B) PPA	2012	no	no
n	y	n	n	y	50	PV (4.7 MW DC Fixed Tilt) PPA	2011	no	no

Table 18: Measures 34 – 50 Photovoltaic Projects

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
n	n	n	n	n	51	Energy Efficient Appliance Rebate Program (local offset)	2012	no	yes
n	n	n	n	n	52	HVAC Maintenance Energy Efficiency Program (local offset)	2012	no	yes
n	n	n	n	n	53	Non-Residential On-site audits (local offset)	2012	no	yes
n	n	n	n	n	54	Residential and Commercial Energy Efficiency and Solar Loan funding (local offset)	2014	no	yes
n	n	n	n	n	55	Residential Duct Testing and Sealing (local offset)	2013	no	yes
n	n	n	n	n	56	Residential New Construction M&V Programs (local offset)	2013	no	yes
n	n	n	n	n	57	Residential On-site audit and energy efficiency upgrades program (local offset)	2014	no	yes
n	n	n	n	n	58	Residential Solar Electric Generation programs (local offset)	2012	no	yes
n	n	n	n	n	59	Weatherization Assistance (local offset)	2011	no	yes
n	n	n	n	y	60	Water Efficiency Upgrade Project-retrofit of parks (Stimulus funded)	2012	no	yes
n	n	y	y	n	61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	2010	yes	no
n	n	n	n	n	62	Direct Load Control Project (local offset)	2014	no	yes
n	n	n	n	n	63	Business Solar Energy Installation (local offset)	2010	no	yes
y	y	y	y	y	64	Traffic Operational Improvements '04-'05 (Offset)	2005	no	no
y	y	y	y	y	65	Traffic Operational Improvements '06-'07 (Offset)	2007	no	no
y	y	y	y	y	66	Traffic Operational Improvements '08-'09 (Offset)	2009	no	no
n	n	n	n	y	67	Traffic Operational Improvements '10-'12 (Offset)	2012	no	yes
n	n	n	n	y	68	Traffic Operational Improvements '13-'15 (Offset)	2014	no	yes

Table 19: Measures 51 – 68 Stimulus Funded and Local Carbon Offset Projects

Action Plans					Measure Number	Measure Name	Implementation Date	Financed	Grant Funding
A	B	C	D	E					
y	y	y	y	y	69	PV 8 kW AC RSVL Aquatic CTR (predates analysis)	1997	no	no
y	y	y	y	y	70	PV 18.6 kW AC Fire Station #6	2002	no	no
y	y	y	y	y	71	PV 10 kW AC Middle School	2006	no	no
y	y	y	y	y	72	PV 10 kW AC City Hall	2006	no	no
y	y	y	y	y	73	City Various Buildings - Lighting: 13 Locations	2002	no	no
y	y	y	y	y	74	Various - Vending Misers and Chiller: Oak St. and Main Library	2003	no	no
y	y	y	y	y	75	Dry Creek Motors	2004	no	no
y	y	y	y	y	76	Police Department and Maidu Library	2004	no	no
y	y	y	y	y	77	Corp Yard Task Lighting	2005	no	no
y	y	y	y	y	78	Multiple Building Energy Efficiency Measures	2007	no	no

Table 20: Completed Projects

Measures Results

The measures considered for inclusion in the plans are described below. Each measure includes a table indicating which Action Plans include that measure. For example, Measure 12: Restaurant Grease to Methane Gas Program is included in Plans B, C, and D as indicated by "y" under each plan ("n" indicating not included in the plan).

Action Plan				
A	B	C	D	E
n	y	y	y	n

The description of each measure also includes a table listing the results of the measure: the cost of implementation, the annual savings, the GHG impact and the financial metrics of Simple Payback, Internal Rate of Return (IRR) and Net Present Value (NPV). Again using Measure 12 as an example:³²

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
12	39.6	0	2012	\$3,460,000	\$0	(\$206,680)	\$0	City Financed	17	7.0%	\$808,202

Finally, each measure table includes an evaluation score to enable to allow a comparison of the benefits of each opportunity. The score is drawn from the Action Plan Evaluation tables in the appendices, page 131.

The measures considered in this analysis are listed in the following pages, with a brief description of each. The background information for many of the measures is provided in the appendices which also includes the list of Federal Stimulus projects. The cost benefit data was not available for a portion of the Stimulus funded measures at the time of this analysis. They are available to be included when the cost and benefit information becomes available.

³² The negative annual O&M Cost equates to annual cost savings. The savings are operational in nature, not resulting from energy savings. Also note that the CO2e savings are zero. The methane generated by this program is attributed to the associated co-generation project.

Action Plan				
A	B	C	D	E
n	y	y	y	y

1-Roseville Aquatic Center Solar Thermal (Federal Stimulus funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
1	42.3	28	2010	\$300,000	\$5,356	\$0	\$0	Grant	NA	na	\$106,341

This project is described in the application for federal stimulus funding.

The City of Roseville, in order to provide a place for physical activity and recreation, owns and operates an aquatic center. The aquatic center is a year round facility that works in conjunction with Wood Creek High School. As a year round facility there is a requirement to keep the pool heated to the competition standard of 82 degrees.

Currently the pool is heated by a series of inefficient natural gas boilers that use approximately 100,000 therms of natural gas per year. The City has been working with Altus Energy to develop the specifications and requirements of a solar thermal system. A plan has been developed that addresses the needs of the facility and requires 7,000 sqft of solar array. The roof structure at the Aquatics Center will not support a system of that size. In order to make accommodations for the system a structure needs to be constructed.

Our plan is to construct the structure over the existing parking area providing shade for the parked vehicles and avoiding any further encroachment into an open space area. The estimated cost for the structure is \$300,000 and has been designed to meet our specifications.³³

Location	Size	Cost	Yearly Energy Output
Roseville Aquatic Solar Thermal Project	7000 sqft	\$300,000	1.96 billion BTU

³³ City of Roseville, California Solar Thermal Installation Project, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	y	y	y	y

2-Building Solar Thermal (PPA funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
2	32.3	82	2010	\$0	(\$14,917)	\$0	\$0	PPA	NA	64.8%	(\$141,566)

This measure specifies solar hot water systems for a number of city building displacing the natural gas currently used with the building water heaters. These projects are funded utilizing a power purchase agreement as specified in the letter of intent.³⁴

This measure is analyzed using the following provisions

- 1) The solar thermal equipment will be installed and located at the Roseville Police Station, Fire Stations 1, 2, 3, 4, 6 and 7 and the Roseville Sports Complex.
- 2) The City will receive all Greenhouse Gas Credits, estimated at 82 tons per year.
- 3) The City will have the solar thermal equipment installed and maintained at no cost to the City at the locations above for approximately twenty (20) consecutive years.
- 4) The City will receive energy at \$.90/therm, a 10% discount from current energy costs, beginning in year 1 with an annual escalation in energy costs of 7.5% each year.

Assumptions used in this analysis:

- a. tons = metric tons
- b. Natural Gas (NG) yields 12.340 lbs CO2e/therm
- c. Utility provided NG cost = 1.000 \$/therm
- d. The systems will displace 14,650 therms of natural gas annually.
- e. Utility provided NG cost escalation rate = 3.5%
- f. Contract escalation rate = 7.5%

³⁴ City of Roseville Solar Thermal Power Purchase Agreement Letter of Intent to Proceed, April 2, 2009

Action Plan				
A	B	C	D	E
n	y	y	y	n

3-City Facilities Energy Efficiency (City funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
3	76.3	2021	2011	\$2,000,000	\$768,231	\$0	\$0	Perform Contract	NA	NA	\$13,347,745

This project is described in the application for federal stimulus funding. However, Measure 3 incorporates these opportunities as city funded projects utilizing the performance contracting funding scenario. The complete text describing these projects is provided in the appendices.

The City of Roseville owns and operates administrative buildings, fire stations, a city jail, parks, community centers, and educational facilities which service the 31 square miles with the city limits. Energy efficiency within all existing and in all new buildings has been a management priority. The City last performed a major City-wide energy audit in 2001. This audit has served as the “guidebook” for energy efficiency projects since then. The \$2,000,000 requested will serve several essential functions:

1. *Allow the City to meet the objectives of the City’s Climate Action Plan – now in development – for green house gas reductions.*
2. *Establish energy use benchmarks for each facility to be used to guide facility staff in performing future energy efficiency projects.*
3. *Provide the project funding to address energy efficiency projects which have been previously identified.*
4. *Provide the project funding to complete energy efficiency projects to be identified via the proposed energy audit. (Random surveys by staff indicate that these projects do exist.)*
5. *Provide substantial operational cost savings via lower energy bills for City facilities.*
6. *Roseville is a city that acts as a trend setter for many cities throughout California, these projects assist others cities in their efforts to promote energy efficiency and green house gas reduction³⁵.*

³⁵ City of Roseville, California City Facility Energy Efficiency Project

Action Plan				
A	B	C	D	E
n	n	n	n	y

4-City Facilities Energy Efficiency (Federal Stimulus Funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
4	97.0	2021	2011	\$2,000,000	\$768,231	\$0	\$0	Grant	NA	NA	\$15,252,507

This is the same project as Measure 3 except that it assumes 100% funding from the federal stimulus program. Therefore the effective net capital cost is zero. The project is described in the application for federal stimulus funding provided in the appendices.

The City of Roseville owns and operates administrative buildings, fire stations, a city jail, parks, community centers, and educational facilities which service the 31 square miles with the city limits. Energy efficiency within all existing and in all new buildings has been a management priority. The City last performed a major City-wide energy audit in 2001. This audit has served as the “guidebook” for energy efficiency projects since then. The \$2,000,000 requested will serve several essential functions:

1. *Allow the City to meet the objectives of the City’s Climate Action Plan – now in development – for green house gas reductions.*
2. *Establish energy use benchmarks for each facility to be used to guide facility staff in performing future energy efficiency projects.*
3. *Provide the project funding to address energy efficiency projects which have been previously identified.*
4. *Provide the project funding to complete energy efficiency projects to be identified via the proposed energy audit. (Random surveys by staff indicate that these projects do exist.)*
5. *Provide substantial operational cost savings via lower energy bills for City facilities.*
6. *Roseville is a city that acts as a trend setter for many cities throughout California, these projects assist others cities in their efforts to promote energy efficiency and green house gas reduction³⁶.*

³⁶ City of Roseville, California City Facility Energy Efficiency Project

Action Plan				
A	B	C	D	E
n	n	n	n	y

5-Streetlighting High Intensity Discharge Lamps (HID) to LED (Federal Stimulus Funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
5	84.4	933	2012	\$10,030,000	\$368,079	(\$30,756)	\$0	Grant	NA	NA	\$7,918,500

This project is described in the application for federal stimulus funding. It assumes 100% funding from the federal stimulus program. Therefore the effective net capital cost is zero.

The City of Roseville owns and maintains 12,260 street lights that illuminate intersections, corridors and subdivision streets at night within the City of Roseville service territory. There are a variety of existing street lighting fixtures that are HID sources that require ballasts to operate. Since LED's, area new high efficiency light source, they have significant opportunities to reduce energy use in street lighting applications. Street lights operate approximate 4100 hours per year in our service territory. Approximately 45-65% of the energy used by the light is reduced when replacing HID street light fixtures with LED light technologies, as shown below.³⁷

Location	# of fixtures to retrofit	Cost	Design	Yearly kWh Saved
City of Roseville Street lights	12,260	\$10,030,000	High efficiency LED Fixture heads to replace HID	3,009,000 kWh

³⁷ City of Roseville, California LED Street Light Project, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	y	n

6- Streetlighting High Intensity Discharge Lamps (HID) to LED (City funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
6	17.0	266	2012	\$3,711,264	\$22,982	(\$12,303)	\$0	Perform Contract	105	0.0%	(\$2,833,995)

This measure is similar to the previous street lighting measure except that the project is funded by the city. Forty percent of the city streetlights are converted to light emitting diode (LED) technology or a similar strategy saving 30% of the energy consumption of the lamps. The cost per fixture is based on the documentation supplied by Staff in the federal stimulus funding application (\$818 per fixture). The analysis includes maintenance savings as well as energy cost savings (calculated at \$.023/kWh). The table below provides the values used in the analysis. The street lighting base data supporting these calculations is provided in the appendices.

Streetlight Retrofit Assumptions	
7,161,815	kWh: Streetlight
859,418	kWh saved with this measure
11,341	Number of fixtures
40%	Percentage of fixtures in this measure
4536	Number of fixtures affected
\$818	Incremental cost per fixture
30%	Reduction in consumption
\$20,028	Energy Cost Savings (assumed proportional to energy saved)
\$12,303	Maintenance Savings (based on ratio of lamp life, assumes 75% cost related to lamp burnout)
Lamp Life	(for implementation schedule, reduced maintenance)
24,000	hours (HPS)
4380	annual hours of operation per year
5.5	years of operation
70,000	hours (LED)
4380	annual hours of operation per year
16.0	years of operation

Action Plan				
A	B	C	D	E
n	n	n	y	n

7- Streetlighting High Intensity Discharge Lamps (HID) to LED (City Funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
7	17.0	266	2012	\$3,711,264	\$22,982	(\$12,303)	\$0	Perform Contract	NA	0.0%	(\$2,833,995)

This measure affects the second 40% of street lighting fixtures utilizing the same assumptions and values as the previous measure. When combined with Measure 6, 80% of the street lighting inventory would be converted to LED or similar strategy. The street lighting base data supporting these calculations is provided in the appendices.

Streetlight Retrofit Assumptions	
7,161,815	kWh: Streetlight
859,418	kWh saved with this measure
11,341	Number of fixtures
40%	Percentage of fixtures in this measure
4536	Number of fixtures affected
\$818	Incremental cost per fixture
30%	Reduction in consumption
\$20,028	Energy Cost Savings (assumed proportional to energy saved)
\$12,303	Maintenance Savings (based on ratio of lamp life, assumes 75% cost related to lamp burnout)
Lamp Life	(for implementation schedule, reduced maintenance)
24,000	hours (HPS)
4380	annual hours of operation per year
5.5	years of operation
70,000	hours (LED)
4380	annual hours of operation per year
16.0	years of operation

Action Plan				
A	B	C	D	E
n	n	y	n	n

8-Streelighting: Reduce Residential Lumins 50%

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
8	38.2	747	2010	\$435,500	\$59,197	\$0	\$0	City Financed	7	16.9%	\$760,542

This measure involves the reduction of street lighting intensity by roughly 50%. The assumptions used in quantifying the benefits are provided in the table below. There is little cost associated with this measure as the lamps are assumed to be changed out upon burnout. The cost would increase if the schedule for implementation were accelerated. The street lighting base data supporting these calculations is provided in the appendices.

Residential reduced illumination assumptions	
4,742,714	kWh: Residential Streetlight
2,371,357	kWh saved with this measure
8,710	Number of Residential fixtures
100%	Percentage of Residential fixtures in this measure
8710	Number of fixtures affected
\$50	Incremental cost per fixture
50%	Reduction in consumption
\$252,787	Energy Savings (assumes cost savings proportional to energy savings)
\$0	Maintenance Savings (based on ratio of lamp life, assumes 75% cost related to lamp burnout)

Action Plan				
A	B	C	D	E
n	n	n	n	n

9- Streetlighting: Darken 50% of Fixtures

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
9	34.4	747	2010	\$217,750	\$59,197	\$15,378	\$0	no	5	24.1%	\$662,604

This measure “turns off” half of the residential street lighting fixtures saving over 2,000,000 kWh annually. The large NPV for this measure is due to reduced annual tariff payment to the utility which would need to be negotiated. This measure can also be modified to reflect availability of devices designed to switch streetlights off for a portion of the early morning hours. The assumptions behind the costs and benefits calculation are provided in the tables below. The street lighting base data supporting these calculations is provided in the appendices.

Streetlight Retrofit Assumptions	
4,742,714	kWh: Residential Streetlight
2,371,357	kWh saved with this measure
8,710	Number of Residential fixtures
50%	Percentage of Residential fixtures in this measure
4355	Number of fixtures affected
\$50	Incremental cost per fixture
100%	Reduction in consumption
\$55,261	Energy Savings (assumes cost savings proportional to energy savings)
\$15,378	Maintenance Savings (based on ratio of lamp life, assumes 75% cost related to lamp burnout)

Action Plan				
A	B	C	D	E
n	n	n	n	n

10- Streetlighting: Darken 50% of Fixtures

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
10	39.8	747	2010	\$217,750	\$59,197	(\$15,378)	\$0	no	3	38.9%	\$1,273,241

This measure “turns off” the second half of the residential street lighting fixtures saving another 2,000,000 kWh annually. The large NPV for this measure is due to reduced annual tariff payment to the utility which would need to be negotiated. This measure can also be modified to reflect availability of devices designed to switch streetlights off for a portion of the early morning hours. The assumptions behind the costs and benefits calculation are provided in the tables below. The street lighting base data supporting these calculations is provided in the appendices.

Streetlight Retrofit Assumptions	
4,742,714	kWh: Residential Streetlight
2,371,357	kWh saved with this measure
8,710	Number of Residential fixtures
50%	Percentage of Residential fixtures in this measure
4355	Number of fixtures affected
\$50	Incremental cost per fixture
100%	Reduction in consumption
\$55,261	Energy Savings (assumes cost savings proportional to energy savings)
\$15,378	Maintenance Savings (based on ratio of lamp life, assumes 75% cost related to lamp burnout)

Action Plan				
A	B	C	D	E
n	y	y	y	y

11- Pleasant Grove WWTP CoGeneration Plant

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
11	48.1	1211	2014	\$7,000,000	\$520,394	\$93,208	\$0	Perform Contract	16	7.2%	\$1,814,710

This measure is based on the technical evaluation provided by Carollo Engineers for the City of Roseville. Several options are evaluated in the Carollo report. This analysis utilizes the values associated with Alternative 1B, one 540 kW Conventional Reciprocating Engine. City of Roseville staff have recommended an assumed cost of \$7M for the cogeneration facility.

The City of Roseville (City) is currently expanding the Pleasant Grove Wastewater Treatment Plant (PGWWTP). As part of PGWWTP 2009, anaerobic digesters are being added to the facility. The purpose of this Technical Memorandum (TM) is to present the results of an evaluation of alternative technologies for digester gas fueled cogeneration including available cogeneration technology incentives to save operational costs and to be consistent with the City's "Green" technology focus.

Alternatives 1A and 1B, 560 kW and 540 kW Engine Generator Alternatives, have the greatest present worth savings. Alternatives 1A and 1B, 560 kW and 540 kW Engine Generator Alternatives, are nearly equal to the recommended Alternative 3 in all regards except cost.³⁸

A project description is available in the report referenced above. The technical details used in this analysis are provided in the appendices.

³⁸ City of Roseville Pleasant Grove Wastewater Treatment Plant Expansion Technical Memorandum No. 10 Cogeneration Facility Analysis Final, Carollo Engineers, January 2008.

Action Plan				
A	B	C	D	E
n	y	y	y	n

12- Restaurant Grease to Methane Gas Program (City funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
12	39.6	0	2012	\$3,460,000	\$0	(\$206,680)	\$0	City Financed	17	7.0%	\$808,202

This project is described in the application for federal stimulus funding. However, Measure 12 incorporates this program as a city funded project utilizing standard city financing for funding. The complete text describing these projects is provided in the appendices.

The Environmental Utilities Department, which operates the city's wastewater utility, has recently implemented a Fat's, Oils and Grease (FOG) Program per the Roseville Municipal Code that helps meet state law and reduce sewer blockages and overflows that could impair area surface water. The FOG Program has implemented grease hauling standards for restaurants that produce cooking fats and grease. This project will ensure the integrity of that process, provide a convenient location for grease haulers to dispose of their waste, and provide a constant supply source of renewable methane gas by processing it through a modified anaerobic digester. That methane will be used to cycle back into the wastewater treatment plant to lessen its reliance upon the electric grid and shrink its carbon footprint.

Action Plan				
A	B	C	D	E
n	y	y	y	y

13- Restaurant Grease to Methane Gas Program (Federal Stimulus funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
13	52.1	0	2012	\$3,460,000	\$0	(\$206,680)	\$0	Grant	NA	0.0%	\$4,103,440

This is the same project as Measure 12 except that it assumes 100% funding from the federal stimulus program. Therefore the effective net capital cost is zero. The project is described in the application for federal stimulus funding provided in the appendices.

The Environmental Utilities Department, which operates the city's wastewater utility, has recently implemented a Fat's, Oils and Grease (FOG) Program per the Roseville Municipal Code that helps meet state law and reduce sewer blockages and overflows that could impair area surface water. The FOG Program has implemented grease hauling standards for restaurants that produce cooking fats and grease. This project will ensure the integrity of that process, provide a convenient location for grease haulers to dispose of their waste, and provide a constant supply source of renewable methane gas by processing it through a modified anaerobic digester. That methane will be used to cycle back into the wastewater treatment plant to lessen its reliance upon the electric grid and shrink its carbon footprint.

Action Plan				
A	B	C	D	E
n	y	y	y	y

14- CoGeneration Plant Supporting Grease to Gas Program

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
14	26.4	1348	2012	\$7,000,000	\$542,405	\$226,193	\$0	Perform Contract	22	4.5%	(\$388,573)

The creation of a restaurant grease to methane gas program at the Dry Creek facility would require additional generating capacity to utilize the additional methane produced.

A FOG receiving program would increase the amount of digester gas produced by the digesters, and a cogeneration system could utilize the excess gas to produce electricity and heat.³⁹

This substantial investment for this additional generating capacity is represented by an estimate provided for the Pleasant Grove facility by Carollo Engineers. While the Pleasant Grove analysis provides a useful appreciation of the scale of such a project, the actual costs and benefits require an analysis for the Dry Creek facility which would be undertaken if this measure is pursued. Several options are evaluated in the Carollo report. This analysis utilizes the values associated with Alternative 3: Two 300 kW Fuel Cell Cogeneration Facility.

Alternative 3 consists of installing two 300-kW fuel cell units complete with heat recovery and fuel treatment equipment (see TM No. 7), installed outdoors on a concrete pad. A fuel cell plant producing 600 kW (full output) will require 130 scfm of digester gas. Note that, with the possible exception of the first year or two, there will be sufficient digester gas always available to fuel the 600 kW fuel cell project. Provisions will be made to easily allow an additional unit to be installed in the future.

As the current SGIP⁴⁰ is reviewed and adjusted every year, there is significant risk that the current level of grant funding will be reduced or eliminated in the future. Without grant funding, the fuel cell system would not be cost effective. Since digester gas would not be produced until 2011, it is recommended that the future cogeneration facility should not be designed and constructed until grant funding from the SGIP is confirmed.⁴¹

A project description is available in the report referenced above. The technical details used in this analysis are provided in the appendices

³⁹ Fats, Oils, and Grease (FOG) Receiving Station Feasibility Study, Kennedy/Jenks Consultants, March 31, 2008

⁴⁰ Self-Generation Incentive Program

⁴¹ City of Roseville Pleasant Grove Wastewater Treatment Plant Expansion Technical Memorandum No. 10 Cogeneration Facility Analysis Final, Carollo Engineers, January 2008.

Action Plan				
A	B	C	D	E
n	y	n	n	n

15- Transit Bus Replacement Strategy A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
15	53.3	123	2011	\$350,763	\$247,821	\$0	\$0	City Financed	1	76.6%	\$4,586,193

The compressed natural gas (CNG) replacements specified in this measure will result in considerable gasoline and diesel fuel savings and avert roughly 123 metric tons of CO2e annually. The costs are based on the cost data provided by the Metropolitan Transportation Commission (MTC) and assume an 80% cost sharing by the federal government. The table of values provided by MTC is provided below. The analysis assumes this measure would be fully implemented by 2011. The table of vehicle replacements is provided in the appendices. The measures below illustrate one method to reduce emissions. Ultimately, an increasingly fuel efficient transit fleet could result from a technology not listed below. In any case, the comprehensive path forward for the transit fleet will require a feasibility study according to the Transit team.

Units	Original Unit Description	Replacement	Fuel	MPG	Incremental Cost
8	G33503	Cut-Away/Van 26'+, 7-Year, CNG	CNG	8.42	\$13,970
5	15 pass	Cut-Away/Van 26'+, 7-Year, CNG	CNG	7.83	\$13,970
2	GLAVAL 15P	Cut-Away/Van 26'+, 7-Year, CNG	CNG	7.90	\$13,970
3	28 Pass	Transit Bus 30' CNG	CNG	3.50	\$10,253
4	Bus	Transit Bus 40' CNG	CNG	3.95	\$11,045
5	Phantom 42	Transit Bus 40' CNG	CNG	5.08	\$11,045
1	42 Pass	Transit Bus 40' CNG	CNG	7.39	\$11,045

Action Plan				
A	B	C	D	E
n	n	y	y	y

16-Transit Bus Replacement Strategy B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
16	43.3	162	2011	\$561,983	\$128,494	\$0	\$0	City Financed	4	27.0%	\$2,015,911

The Hybrid Diesel and compressed natural gas (CNG) replacements will save over 160 metric tons of CO2e and result in considerable gasoline and diesel fuel savings annually. The costs are based on the cost data provided by the Metropolitan Transportation Commission (MTC) and assume an 80% cost sharing by the federal government. The table of values provided by MTC is provided below. The analysis assumes this measure would be fully implemented by 2011. The table of vehicle replacements for this measure is provided in the appendices. The measures below illustrate one method to reduce emissions. Ultimately, an increasingly fuel efficient transit fleet could result from a technology not listed below. In any case, the comprehensive path forward for the transit fleet will require a feasibility study according to the Transit team.

Units	Original Unit Description	Replacement	Fuel	MPG	Incremental Cost
8	G33503	Cut-Away/Van 26'+, 7-Year, CNG	CNG	8.42	\$13,970
5	15 pass	Cut-Away/Van 26'+, 7-Year, CNG	CNG	7.83	\$13,970
2	GLAVAL 15P	Cut-Away/Van 26'+, 7-Year, CNG	CNG	7.90	\$13,970
3	28 Pass	Transit Bus 30' CNG	CNG	3.50	\$10,253
4	bus	Transit Bus 40' Hybrid	Diesel	5.13	\$32,167
5	PHANTOM 42	Transit Bus 40' Hybrid	Diesel	6.60	\$32,167
1	42 PASS	Transit Bus 40' Hybrid	Diesel	9.61	\$32,167

Action Plan				
A	B	C	D	E
n	n	y	y	y

17-Fleet Management Software Efficiency Initiatives

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
17	36.7	172	2010	\$0	\$65,201	\$3,570	\$0	no	NA	0.0%	\$1,223,629

The city's vehicles are monitored with Fleet Management Software providing performance information and coordinating maintenance efforts on each unit in the city fleet. The mileage and fueling documentation available provides information to reduce unnecessary or inefficient travel patterns. In addition to these fuel savings, the performance data from each vehicle can provide early indications of mechanical issues that reduce fuel efficiency. The assumptions used in determining the costs and benefits of this measure are provided in the table below. The estimated annual maintenance costs are based on data from a similar sized municipality (scaled by total fleet fuel consumption).

Fleet Management Software	
Software Cost Estimate	\$0
.25 FTE Staff Costs (1FTE=\$60k)	\$15,000
Fuel Savings Estimate	5.0%
Annual Gas Savings	7,130
Annual Diesel Savings	11,019
Maintenance Estimated Costs	\$1,857,005
Maintenance Cost Savings (%)	1%
Maintenance Cost Savings	\$18,570

Action Plan				
A	B	C	D	E
n	y	n	n	n

18-Fleet Replacement Strategy A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
18	56.5	523	2011	\$404,000	\$215,959	\$0	\$0	City Financed	2	58.8%	\$3,902,899

The fleet changes specified in the table below are projected to save over 55,000 gallons of fuel annually, resulting in roughly 520 metric tons of CO2e avoided annually. A total of 192 units are specified for replacement. The costs are based on the estimated incremental cost of purchasing the more efficient alternative rather than the current model or equivalent. The analysis assumes this measure would be fully implemented by 2011. Incremental reductions would accrue prior to the completion date as the more efficient models are employed. A complete list of specific vehicles and the associated strategies is provided in the appendices.

Strategy					
Count	Original	Replacement	Fuel	Mile per Gallon	Incremental Cost
24	TAURUS	Sedan Plugin	Gasoline	60.00	8000
17	STRATUS	Sedan Plugin	Gasoline	60.00	8000
6	CIVIC	Sedan Plugin	Gasoline	60.00	8000
3	LUMINA	Sedan Plugin	Gasoline	60.00	8000
2	CIERA	Sedan Plugin	Gasoline	60.00	8000
1	ACCORD	Sedan Plugin	Gasoline	60.00	8000
1	ESCAPE	Small SUV hybrid	Gasoline	30.00	4000
4	DURANGO	large SUV Hybrid	Gasoline	21.00	4000
5	EXPEDITION	large SUV Hybrid	Gasoline	21.00	4000
4	TAHOE	large SUV Hybrid	Gasoline	21.00	4000
1	TRAILBLAZER	large SUV Hybrid	Gasoline	21.00	4000
124	CRN VIC	Chevy Impala	Gasoline	20.00	0

Action Plan				
A	B	C	D	E
n	n	y	y	y

19- Fleet Replacement Strategy B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
19	71.2	1562	2012	\$5,059,000	\$967,671	\$0	\$0	City Financed	5	23.0%	\$14,394,115

The fleet changes specified in the table below are projected to save over 295,000 gallons of gasoline and diesel fuel annually, resulting in over 1,500 metric tons of CO2e avoided annually. A total of 391 units are addressed including 42 refuse truck converted to CNG using the assumptions in the Stimulus Grant application⁴². The analysis assumes this measure would be fully implemented by 2012. Incremental reductions would accrue prior to the completion date as the more efficient models are employed. A complete list of specific vehicles and the associated strategies is provided in the appendices.

Strategy						Strategy					
Count	Original	Replacement	Fuel	Mile per Gallon	Incremental Cost	Count	Original	Replacement	Fuel	Mile per Gallon	Incremental Cost
24	TAURUS	All Electric Sedan	Electric	2.1	\$10,000	21	COLORADO	Electric SUT	Electric	2.1	\$15,000
17	STRATUS	All Electric Sedan	Electric	2.1	\$10,000	6	S-10 PU	Electric SUT	Electric	2.1	\$15,000
6	CIVIC	All Electric Sedan	Electric	2.1	\$10,000	15	F-150	Diesel hybrid Pickup	Diesel	21	\$6,000
3	LUMINA	All Electric Sedan	Electric	2.1	\$10,000	20	F-250	Diesel hybrid Pickup	Diesel	21	\$6,000
2	CIERA	All Electric Sedan	Electric	2.1	\$10,000	8	RAM 1500	Diesel hybrid Pickup	Diesel	21	\$6,000
1	ACCORD	All Electric Sedan	Electric	2.1	\$10,000	24	RAM 2500	Diesel hybrid Pickup	Diesel	21	\$6,000
42	Refuse Truck	Refuse Truck CNG	CNG	0.28	\$60,000	24	SILVERADO	Diesel hybrid Pickup	Diesel	21	\$6,000
1	ESCAPE	Small SUV Hybrid	Gasoline	30	\$4,000	4	C-1500	Diesel hybrid Pickup	Diesel	21	\$6,000
4	DURANGO	Large SUV Hybrid	Gasoline	21	\$4,000	13	C-2500	Diesel hybrid Pickup	Diesel	21	\$6,000
5	EXPEDITION	Large SUV Hybrid	Gasoline	21	\$4,000	25	F-350	Diesel hybrid Lg Truck	Diesel	9	\$6,000
4	TAHOE	Large SUV Hybrid	Gasoline	21	\$4,000	2	F-450	Diesel hybrid Lg Truck	Diesel	9	\$6,000
1	TRAILBLAZER	Large SUV Hybrid	Gasoline	21	\$4,000	25	C-3500	Diesel hybrid Lg Truck	Diesel	9	\$6,000
35	DAKOTA	Electric SUT	Electric	2.1	\$15,000	10	SIERRA-3500	Diesel hybrid Lg Truck	Diesel	9	\$6,000
12	RANGER	Electric SUT	Electric	2.1	\$15,000	10	RAM 3500	Diesel hybrid Lg Truck	Diesel	9	\$6,000
27	SONOMA	Electric SUT	Electric	2.1	\$15,000						

⁴² City of Roseville, California Refuse Truck Hybridization/CNG, April 2009. Text provided in appendices.

Action Plan				
A	B	C	D	E
n	n	n	n	n

20- Biodiesel 5%

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
20	-9.1	121	2010	\$0	(\$6,077)	\$0	\$0	no	NA	NA	(\$120,662)

This measure changes the fuel mix for all diesel vehicles to a 5/95% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

21-Biodiesel 20%

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
21	7.5	483	2010	\$1,500	(\$24,310)	\$0	\$0	no	NA	NA	(\$484,077)

This measure changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

22 – Biodiesel 50%

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
22	15.9	1207	2010	\$51,500	(\$60,775)	\$0	\$0	no	NA	NA	(\$1,255,670)

This measure changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

23- Biodiesel 99%

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
23	20.9	2389	2010	\$51,500	(\$120,334)	\$0	\$0	no	NA	NA	(\$2,438,160)

This measure changes the fuel mix for all diesel vehicles to a 99/1% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel (regulatory issues require 1% diesel). Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	y	n	n	n

24- Biodiesel 20% Linked to Fleet Replacement Strategy A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
24	4.5	483	2010	\$1,500	(\$24,310)	\$0	\$0	no	NA	NA	(\$484,077)

This measure, applied after Fleet Replacement Strategy A fuel savings, changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	y	n	n

25- Biodiesel 20% Linked to Fleet Replacement Strategy B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
25	-1.0	251	2010	\$1,500	(\$12,631)	\$0	\$0	no	NA	NA	(\$252,205)

This measure, applied after Fleet Replacement Strategy B fuel savings, changes the fuel mix for all diesel vehicles to a 20/80% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

26- Biodiesel 50% Linked to Fleet Replacement Strategy A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
26	10.9	1207	2010	\$51,500	(\$60,775)	\$0	\$0	no	NA	NA	(\$1,255,670)

This measure, applied after Fleet Replacement Strategy A fuel savings, changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

27- Biodiesel 50% Linked to Fleet Replacement Strategy B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
27	7.9	627	2010	\$51,500	(\$31,577)	\$0	\$0	no	NA	NA	(\$675,989)

This measure, applied after Fleet Replacement Strategy B fuel savings, changes the fuel mix for all diesel vehicles to a 50/50% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel. Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	n	n

28- Biodiesel 99% Linked to Fleet Replacement Strategy A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
28	10.9	1207	2010	\$51,500	(\$60,775)	\$0	\$0	no	NA	NA	(\$1,255,670)

This measure, applied after Fleet Replacement Strategy A fuel savings, changes the fuel mix for all diesel vehicles to a 99/1% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel (regulatory issues require 1% diesel minimum). Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	n	n	y	y

29- Biodiesel 99% Linked to Fleet Replacement Strategy B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
29	10.9	1241	2010	\$51,500	(\$62,523)	\$0	\$0	no	NA	NA	(\$1,290,391)

This measure, applied after Fleet Replacement Strategy B fuel savings, changes the fuel mix for all diesel vehicles to a 99/1% (biodiesel/diesel) blend for all fleet vehicles currently using diesel fuel (regulatory issues require 1% diesel minimum). Biodiesel is now readily available at a reasonable price allowing rapid implementation of this GHG reduction strategy. This analysis assumes \$3.39 per gallon and no cost for infrastructure improvements (tanks, etc). Prices are assumed to escalate at the same rate as petroleum based diesel fuel (8% per year). This analysis also uses the coefficient of 5.24 lbs CO2e per gallon of 100% biodiesel. While the use of biodiesel fuel created from waste oil (assumed to be available locally) would have close to zero emissions for the feedstock, the process requires that 20% of the feed stock is methanol, a petroleum product.

Action Plan				
A	B	C	D	E
n	y	y	y	y

30- Commute Program Enhancement A

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
30	3.0	125	2010	\$0	\$0	\$35,000	\$0	no	NA	NA	(\$694,893)

The general assumptions of a transit demand management (TDM) program are based on the documented cost and impact of successful programs under similar circumstances provided in published case studies. This analysis assumes an increased commute investment of \$35,000 per year resulting in an impact of 10% on the commuting patterns of city employees. The cost is based on a 0.5 FTE position (entry level admin, 1FTE=\$50,000) and \$10,000 per year in program costs. A general summary of commute programs is provided in the appendices. Further study is recommended to allow a more aggressive analysis of commute program impacts. Additional support for commute program development, implementation and evaluation is available from the 511 Regional Rideshare Program.⁴³

⁴³ 511 Regional Rideshare Program, 70 Washington Street, Oakland, CA 94607, (510) 273-3628. <http://www.sacregion511.org/rideshare/>

Action Plan				
A	B	C	D	E
n	n	y	y	y

31- Commute Program Enhancement B

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
31	3.0	125	2011	\$0	\$0	\$35,000	\$0	no	NA	NA	(\$694,893)

This measure increases the investment in commuting programs. As with the previous measure, the general assumptions of a transit demand management (TDM) program are based on the documented cost and impact of successful programs under similar circumstances provided in published case studies. This analysis assumes an additional commute investment of \$35,000 per year resulting in an impact of 10% on the commuting patterns of city employees. The cost is based on a 0.5 FTE position (entry level admin, 1FTE=\$50,000) and \$10,000 per year in program costs. A general summary of commute programs is provided in the appendices. Further study is recommended to allow a more aggressive analysis of commute program impacts. Additional support for commute program development, implementation and evaluation is available from the 511 Regional Rideshare Program.⁴⁴

⁴⁴ 511 Regional Rideshare Program, 70 Washington Street, Oakland, CA 94607, (510) 273-3628. <http://www.sacregion511.org/rideshare/>

Action Plan				
A	B	C	D	E
n	n	n	n	y

32- Staff Efficiency Engineer (or equivalent Staff resources)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
32	-8.0	0	2010	\$0	\$0	\$100,000	\$0	no	NA	NA	(\$1,985,407)

The implementation and monitoring of an aggressive GHG emissions reduction program, and the associated energy cost savings, will be greatly enhanced with the dedicated time of a City Staff member. Plan E includes a 1.0 FTE Efficiency Engineer position representing the staff time allocated to implementing the greenhouse gas action plan. The total cost is estimated to be \$100k per year, increasing with inflation. The expense for this position is included in the financial analyses, and the net cash flow for each plan. Essentially, the cost savings for the added fulltime position are funded when the plans achieve a positive cash flow.

Action Plan				
A	B	C	D	E
n	n	n	y	y

33- Staff Efficiency Coordinator (or equivalent Staff resources)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
33	-8.0	0	2010	\$0	\$0	\$60,000	\$0	no	NA	NA	(\$1,191,244)

This measure substitutes an Efficiency Coordinator for the engineering position specified in the previous measure. The implementation and monitoring of an aggressive GHG emissions reduction program, and the associated energy cost savings, will be greatly enhanced with the dedicated time of a City Staff member. Plans D and E include a 1.0 FTE Efficiency Coordinator position representing the staff time allocated to implementing the greenhouse gas action plan. The total cost is estimated to be \$60k per year, increasing with inflation. The expense for this position is included in the financial analyses, and the net cash flow for each plan. Essentially, the cost savings for the added fulltime position are funded when the plans achieve a positive cash flow.

Action Plan				
A	B	C	D	E
n	n	n	n	n

34- 500 kWdc Photovoltaic Solar System (undefined location) PPA funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
34	21.9	164	2010	\$0	(\$30,213)	\$0	\$0	PPA	NA	NA	(\$326,517)

This measure specifies a 500 kWdc system producing an average of roughly 550,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁴⁵.

The costs reflect the assumption that a power purchase agreement (PPA) will be utilized to implement the system. A power purchase agreement is a long-term agreement between a power provider (the solar company) and a customer. The customer agrees to purchase energy from the provider at a fixed rate for the term of the agreement. This rate increases every year by an agreed percentage. The life of the agreement may be in the range of 20 years. At the end of the contract period the customer typically has the option to purchase the system at its value at that time. This analysis assumes the cost of energy would be 10% more than the current Roseville Electric rate, and would escalate at 5% per year. The analysis also assumes the city retains ownership of the Renewable Energy Credits (REC), and the provider pays all maintenance costs including replacement of the inverters which have a life of roughly 10 years. The cost of energy and its escalation over time specified in the contract will have significant influence over the financial metrics of the measure. The assumed term of the contract matches the term of this analysis, 25 years. The general assumptions underlying the PV production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric System Summary</u>		
System Size (DC)	500	kW DC
System Size (AC)	405.0	(Net AC Kilowatts)
Annual kWh (initial year)	556,498	(kWh/yr)
Final Net Cost	\$2,878,431	(\$)
Rebate	\$10,000	Roseville Electric
Inverter replacement cost	824.00	(\$/kWac)
System Area	40,495	(sq-ft flat)
Performance	1,637	(AC kWh/yr per CEC AC kW installed)

⁴⁵ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	y	n	n	n

35- 300 kWdc Photovoltaic Solar Energy System Single Axis (Dry Creek Plant location) City funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
35	20.5	113	2010	\$1,945,403	\$41,109	\$4,859	\$200,207	City Financed	53	NA	(\$1,410,651)

This measure is included in the Federal Stimulus Package funding application. The analysis assumes this measure is funded by the city using standard financing. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	300	kW DC
System Size	243.0	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	383,984	<u>(kWh/yr)</u>
Final Net Cost	\$1,937,046	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	24,297	<u>(sq-ft flat)</u>
Performance	1,883	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	y	n	y	y

**36- 418 kWdc Photovoltaic Solar Energy System Single Axis
(Pleasant Grove Plant location) PPA funded**

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
36	21.7	156	2011	\$50,000	(\$29,046)	\$0	\$0	PPA	NA	NA	(\$361,533)

This measure is included in the Federal Stimulus Package funding application. The analysis assumes this measure is funded by the city using a power purchase agreement. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	418	kW DC
System Size	338.5	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	535,017	<u>(kWh/yr)</u>
Final Net Cost	\$2,701,592	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	33,854	<u>(sq-ft flat)</u>
Performance	1,883	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	y	n	n	n

37- 683 kWdc Photovoltaic Solar Energy System Fixed Tilt (Barton Road Plant with Time of Use opportunity) City funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
37	26.0	225	2010	\$4,426,937	\$147,304	\$11,063	\$455,805	City Financed	32	NA	(\$2,155,319)

This measure assumes 100% grant funding for the capital cost of this system. The analysis assigns the annual maintenance costs and the replacement of the inverters (roughly 10 years) to be the responsibility of the city. The analysis assumes this measure is funded by the city using standard financing for this measure. The nighttime energy use at this location improves the economics of this strategy.⁴⁶ The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.⁴⁷

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	683	kW DC
System Size	553.2	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	760,176	<u>(kWh/yr)</u>
Final Net Cost	\$4,418,580	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	55,316	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁴⁶ A Time of Use (TOU) factor of 1.81 is used which factors the increased value of energy produced during the day relative to the value of the energy used at the location at night. $$/kWh\ day = 1.81 \times \$/kWh\ night$.

⁴⁷ The GHG savings for this measure differs from the next similar measure due to the variation in power content for 2009 and 2010. See the methodology section for further discussion on the Utility Power Content.

Action Plan				
A	B	C	D	E
n	n	n	n	y

38- 683 kWdc Photovoltaic Solar Energy System Fixed Tilt (Barton Road Plant with Time of Use opportunity) Federal Stimulus funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
38	55.5	225	2010	\$4,426,937	\$81,383	\$11,063	\$455,805	Grant	63	NA	\$742,495

This measure is included in the Federal Stimulus Package funding application. The analysis assumes this measure is 100% funded by through the stimulus grant. The nighttime energy use at this location improves the economics of this strategy.⁴⁸ The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.⁴⁹

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	683	kW DC
System Size	553.2	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	760,176	<u>(kWh/yr)</u>
Final Net Cost	\$4,418,580	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	55,316	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁴⁸ A Time of Use (TOU) factor of 1.81 is used which factors the increased value of energy produced during the day relative to the value of the energy used at the location at night. $$/kWh\ day = 1.81 \times \$/kWh\ night$.

⁴⁹ The GHG savings for this measure differs from the previous similar measure due to the variation in power content for 2009 and 2010. See the methodology section for further discussion on the Utility Power Content.

Action Plan				
A	B	C	D	E
n	y	y	y	n

39- 160 kWdc Photovoltaic Solar Energy System Fixed Tilt (Downtown Parking Area location) PPA funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
39	19.2	52	2012	\$50,000	(\$9,668)	\$0	\$0	PPA	NA	NA	(\$152,105)

This measure specifies a 160 kWdc system producing an average of roughly 178,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵⁰. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	160	kW DC
System Size	129.6	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	178,079	<u>(kWh/yr)</u>
Final Net Cost	\$1,039,958	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	12,958	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵⁰ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	n	n	n	y

**40- 160 kWdc Photovoltaic Solar Energy System Fixed Tilt
(Downtown Parking Area location) Federal Stimulus funded**

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
40	44.0	53	2010	\$1,038,315	\$19,065	\$2,592	\$106,777	Grant	62	NA	\$173,937

This measure assumes 100% grant funding for the capital cost of this system. The analysis assigns the annual maintenance costs and the replacement of the inverters (roughly 10 years) to be the responsibility of the city. This measure specifies a 160 kWdc system producing an average of roughly 178,000 kWh per year. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	160	kW DC
System Size	129.6	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	178,079	<u>(kWh/yr)</u>
Final Net Cost	\$1,039,958	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	12,958	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	y	y	y	n

41- 230 kWdc Photovoltaic Solar Energy System Fixed Tilt (Mahany Park Parking location) PPA funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
41	19.7	76	2010	\$50,000	(\$13,898)	\$0	\$1,161,202	PPA	NA	NA	(\$197,817)

This measure specifies a 230 kWdc system producing an average of roughly 256,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵¹. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	230	kW DC
System Size	186.3	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	255,989	<u>(kWh/yr)</u>
Final Net Cost	\$1,493,502	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	18,628	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵¹ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	n	n	n	y

42- 230 kWdc Photovoltaic Solar Energy System Fixed Tilt (Mahany Park Parking location) Federal Stimulus funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
42	45.6	76	2010	\$1,491,859	\$27,406	\$3,726	\$455,805	Grant	63	NA	\$250,035

This measure assumes 100% grant funding for the capital cost of this system. The analysis assigns the annual maintenance costs and the replacement of the inverters (roughly 10 years) to be the responsibility of the city. This measure specifies a 230 kWdc system producing an average of roughly 256,000 kWh per year. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	230	kW DC
System Size	186.3	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	255,989	<u>(kWh/yr)</u>
Final Net Cost	\$1,493,502	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	18,628	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	y	y	y	n

**43- 305 kWdc Photovoltaic Solar Energy System Fixed Tilt
(Corporation Yard location) PPA funded**

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
43	20.3	99	2011	\$50,000	(\$18,430)	\$0	\$0	PPA	NA	NA	(\$246,794)

This measure specifies a 305 kWdc system producing an average of roughly 340,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵². The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	305	kW DC
System Size	247.0	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	339,464	<u>(kWh/yr)</u>
Final Net Cost	\$1,977,799	<u>(\\$)</u>
Rebate	\$10,000	Roseville Electric
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	24,702	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵² Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	n	n	n	y

**44- 305 kWdc Photovoltaic Solar Energy System Fixed Tilt
(Corporation Yard location) Federal Stimulus funded**

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
44	47.2	100	2010	\$1,977,799	\$36,343	\$4,940	\$203,544	Grant	NA	NA	\$331,568

This measure assumes 100% grant funding for the capital cost of this system. The analysis assigns the annual maintenance costs and the replacement of the inverters (roughly 10 years) to be the responsibility of the city. This measure specifies a 305 kWdc system producing an average of roughly 340,000 kWh per year. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	305	kW DC
System Size	247.0	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	339,464	<u>(kWh/yr)</u>
Final Net Cost	\$1,977,799	<u>(\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	24,702	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	y	y	y	n

**45- 550 kWdc Photovoltaic Solar Energy System Fixed Tilt
(Assorted City locations) PPA funded**

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
45	22.2	181	2010	\$50,000	(\$33,234)	\$0	\$0	PPA	NA	NA	(\$406,788)

This measure specifies a 550 kWdc system producing an average of roughly 612,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵³. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	550	kW DC
System Size	445.4	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	612,148	<u>(kWh/yr)</u>
Final Net Cost	\$3,566,846	<u>(\\$)</u>
Rebate	\$10,000	Roseville Electric
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	44,545	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵³ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	n	n	n	y

46- 550 kWdc Photovoltaic Solar Energy System Fixed Tilt (Assorted City locations) Federal Stimulus funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
46	52.6	181	2010	\$3,565,203	\$65,536	\$8,909	\$367,047	Grant	NA	NA	\$597,910

This measure assumes 100% grant funding for the capital cost of this system. The analysis assigns the annual maintenance costs and the replacement of the inverters (roughly 10 years) to be the responsibility of the city. This measure specifies a 550 kWdc system producing an average of roughly 612,000 kWh per year. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	550	kW DC
System Size	445.4	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	612,148	<u>(kWh/yr)</u>
Final Net Cost	\$3,566,846	<u>(\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	44,545	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	n	n	n	n

47- 1.0 MWdc Photovoltaic Solar Energy System Single Axis (Roseville Energy Park location) Federal Stimulus funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
47	64.1	378	2010	\$6,480,843	\$137,029	\$16,198	\$667,358	Grant	NA	NA	\$1,441,968

This measure is included in the Federal Stimulus Package funding application. However, this project is anticipated to be integrated into the Roseville Electric grid rather than offsetting the energy use of a city utility account. Therefore this system is not included in any of the plans within this analysis but should be included within the Roseville Electric GHG documentation. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	1000	kW DC
System Size	809.9	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	1,279,946	<u>(kWh/yr)</u>
Final Net Cost	\$6,472,486	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	80,990	<u>(sq-ft flat)</u>
Performance	1,883	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	n	n	n	n

48- 1.74 MWdc Photovoltaic Solar Energy System Fixed Tilt (Brownfield Site) Federal Stimulus funded

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
48	72.1	572	2010	\$11,275,451	\$207,331	\$28,185	\$1,161,202	Grant	NA	NA	\$1,891,569

This measure is included in the Federal Stimulus Package funding application. However, this project is anticipated to be integrated into the Roseville Electric grid rather than offsetting the energy use of a city account. Therefore this system is not included in any of the plans within this analysis.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	1740	kW DC
System Size	1,409.2	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	1,936,614	<u>(kWh/yr)</u>
Final Net Cost	\$11,267,094	<u>(\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	140,923	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

Action Plan				
A	B	C	D	E
n	n	y	y	y

49- 320 kWdc Photovoltaic Solar Energy System Fixed Tilt (Energy Source for Electric Vehicles within Replacement Strategy B) PPA

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
49	20.4	104	2012	\$50,000	(\$19,336)	\$0	\$0	PPA	NA	NA	(\$256,590)

This measure specifies a 320 kWdc system producing an average of roughly 356,000 kWh per year, sized to offset the electrical consumption of the plug in electric vehicles specified in Fleet Replacement Strategy B. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵⁴. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	320	kW DC
System Size	259.2	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	356,159	<u>(kWh/yr)</u>
Final Net Cost	\$2,076,630	<u>(\\$)</u>
Rebate	\$10,000	<u>Roseville Electric</u>
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	25,917	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵⁴ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	y	n	n	y

50- 4.7 MWdc Photovoltaic Solar Energy System Fixed Tilt (PPA funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
50	50.9	1525	2011	\$50,000	(\$283,999)	\$0	\$0	PPA	NA	NA	(\$3,116,880)

This measure specifies a 4,700 kWdc system producing an average of roughly 5,230,000 kWh per year. The Net Capital Cost reflects \$50,000 expended to negotiate the PPA contract⁵⁵. The solar energy production calculations are provided in the appendices.

The numbers in the table below are independent of the funding mechanism.

<u>Solar Electric Costs and Benefits Summary</u>		
System Size (DC)	4,700	kW DC
System Size	3,807	<u>(Net AC Kilowatts)</u>
Annual kWh (initial year)	5,231,083	<u>(kWh/yr)</u>
Final Net Cost	\$30,455,526	<u>(\\$)</u>
Rebate	\$10,000	Roseville Electric
Inverter replacement cost	824.00	<u>(\$/kWac)</u>
System Area	380,653	<u>(sq-ft flat)</u>
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>

⁵⁵ Power Purchase Agreement (PPA).

Action Plan				
A	B	C	D	E
n	n	n	n	n

51- Community Energy Efficient Appliance Rebate Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
51	34.1	300	2012	\$500,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

Every home has a wide variety of appliances. These include refrigerators, ovens, microwave ovens, dishwashers, washers and dryers. These appliances vary in age and efficiency.

The program will provide enhanced rebates to all residential customers to proactively replace older appliances with more efficient models. Most homeowners will only replace appliances when they break or if a room remodel dictates a change in color or style. During periods of economic duress appliances are not considered for replacement unless necessary. Upgrading to Energy Star level may not be financially feasible or considered without an enhance rebate

The number of expected participating customers is approximately 5,000 single family dwelling units. This represents just over 10 percent of the total residential customers in the City of Roseville.⁵⁶

⁵⁶ City of Roseville, California Energy –EERE-Energy Efficient Appliance Rebate Program and Energy Star (Middle-Income Families), April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

52- Community HVAC Maintenance Energy Efficiency Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
52	29.0	86	2012	\$900,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

EPA and California based studies (1) have shown air conditioning (AC) systems are typically running 10 to 40 percent below their rated efficiency due to a variety of installation and maintenance problems and that this is occurring in both existing and newly installed and existing AC units. Units that run below their rated efficiencies create higher demands on the electrical grid as they use more energy than necessary when running. The two main problems identified that contribute to this inefficiency are incorrect refrigerant level and poor air flow.

It's also noted that most routine AC maintenance is performed utilizing non-invasive procedures such as cleaning and changing air filters, routine checks on operations, and occasionally assessing level of refrigerant charge. Typically, minimal work is done on proper airflow or proper economizer operation. The cost of performing the more extensive evaluation is cost prohibitive for most customers.

The proposed HVAC maintenance program will perform services beyond what is normally performed during a routine AC service call such as air flow analysis and correction, refrigerant charge correction, economizer repair and demand ventilation controls repair. In addition, this program could be coupled with the duct test and seal program, requested under a separate grant request, for the residential market for even greater efficiencies in program delivery and energy reduction results.⁵⁷

⁵⁷ City of Roseville, California HVAC Maintenance Energy Efficiency Program, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

53- Community Non-Residential On-site Audits Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
53	45.0	1709	2012	\$600,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

In 2000, the City of Roseville's electric utility, Roseville Electric, hired Account Representatives to work closely with our largest energy consuming customers to reduce energy use within their facilities. Since then, the customers have implemented a wide variety of prescriptive efficiency measures to reduce their energy loads and it has become increasingly more difficult to identify new energy saving opportunities.

The ability to hire energy engineering experts to conduct non-residential on-site audits will provide a high level of system analysis to identify energy saving opportunities within our customers' facilities; these opportunities may include efficiencies in process loads, chiller operations, technical system improvements, or retro commissioning of facilities. The reports generated from these audits will include a description of the identified measure, energy savings and demand reductions, estimated costs of implementation, simple paybacks, and additional benefits of implementing the project.

The City of Roseville will provide rebate dollars for peak load projects identified and implemented by our customers. Rebate dollars are not included in this funding request; this request is for costs of conducting the technical audits only.⁵⁸

⁵⁸ City of Roseville, California Nonresidential On-Site Audits, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

54- Community Residential and Commercial Energy Efficiency and Solar Loan Funding Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
54	45.0	7967	2014	\$10,000,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

The City of Roseville will create and implement a 5 year program providing loans as specified under California Assembly Bill 811 (AB811). AB811 was signed into law on July 21, 2008. It is increasingly viewed as an important mechanism for local California governments to fund energy efficiency and renewable energy upgrades by owners of developed property. Project could include new high efficiency air conditioning units, cool roofs, insulation, PV, and other permanent approved project measures. The legislation authorizes cities and counties to enter into contracts with owners of any type of improved real property to fund the installation of specified permanent improvements for renewable energy and energy efficiency. AB811 contractual obligations will be backed up by governmental assessment liens against the improved real property. As in other tax liens, AB811 assessment liens will take first priority over all other private liens and leases. AB811 contracts and the resulting assessment liens are contractual and consensual, which differs from most other assessment liens. Contracts entered into under AB811, depending on the program, may have relatively low interest rates and durations, depending on the terms of the property owner's private contract with the city or county. The improvements funded by the contracts must be permanently installed on the real property. Appliances do not qualify for AB811 funds. Cities and counties have great flexibility in structuring and funding AB811 contracts. Funding can come from a variety of sources, including but not limited to bond proceeds. The maximum amount of any AB811 contract is determined by the lender city or county. The authorized lending entity determines the structure, terms and conditions of each contract. AB811 contract are recorded at the office of the county clerk, recording the notice of the new contractual assessment. If foreclosure occurs, the AB811 assessment lien is treated like that of any assessment lien foreclosure.

AB811 contracts could help California and local cities reduce energy cost and meet the greenhouse gas emissions reduction goals set by California's Global Warming Solutions Act, AB32. Owners who want to make energy efficiency and/or renewable energy improvements, but would not be able to obtain private financing, would have access to market or lower – interest rate loans to improve their property..⁵⁹

⁵⁹ City of Roseville, California Residential and Commercial Energy Efficiency and Solar Electric Loan Funding, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

55- Community Residential HVAC Duct Testing and Sealing Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
55	29.0	85	2013	\$7,500,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

It is common knowledge that leaking ducts in older homes can be very extensive. Studies have shown that existing ducts have systems that leak in a range from 10 percent to 30 percent. Poorly sealed ducts lead to increased HVAC usage, higher energy usage, increased maintenance costs and reduced equipment life. All of these factors lead to increased costs for home owners.

The program will provide for a free duct test on single family residents. Systems that have leaks greater than 10 percent will be repaired at no cost to the home owner. These repairs will improve the existing duct systems to less than 10 percent leakage.

The number of expected customers is approximately 3,000 single family dwelling units. This represents less than 10 percent of the total residential customers in the City of Roseville.⁶⁰

⁶⁰ *City of Roseville, California Residential Duct Testing & Sealing Program, April 2009, See appendices for full text.*

Action Plan				
A	B	C	D	E
n	n	n	n	n

56- Community Residential New Construction M&V Programs (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
56	43.0	670	2013	\$3,750,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

A HERS rated inspector is trained to verify a number of energy efficiency components within a newly constructed house. These inspectors are trained well beyond those performed by any Building Inspection department. These inspectors are not employed by the home builders and are not influenced by any financial pressure. Studies have shown that while home builders produce high quality products, the level of workmanship could be enhanced to increase energy savings for the home owner. These inspections include, but are not limited to, duct sealing, proper duct sizing, proper HVAC sizing, refrigerant charge and envelope.

The program will provide a free comprehensive HERS verification to assure that all homes are complying with building codes, exceeding incentive program requirements and meeting builder expectations.⁶¹

⁶¹ City of Roseville, California Residential New Construction M&V Program, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

57- Community Residential On-site Audit and Energy Efficiency Upgrades Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
57	45.0	850	2014	\$5,000,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

Every home is unique regarding the manner in which it was constructed and maintained. Therefore, each home has a potential for improvements through various energy saving measures. These opportunities are unrealized prior to an on-site audit.

The program will provide free in-home energy audits for single family dwelling units. If the audit identifies energy saving opportunities, the home will be eligible for free repairs or upgrades. These no cost upgrades will include, but are not limited to, weatherstripping, caulking, window film, insulation, CFL's, programmable thermostats and low flow water fixtures in the bathroom and kitchen.

The number of expected participating customers is approximately 5,000 single family dwelling units. This represents just over 10 percent of the total residential customers in the City of Roseville.⁶²

⁶² City of Roseville, California Residential On-Site Audit and Energy Efficiency Upgrades Program, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

58- Community Residential Solar Electric Generation Programs (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
58	44.4	731	2012	\$7,200,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

The City of Roseville, California requests \$7,200,000 in Economic Stimulus funds from the Department of Energy's Energy Efficiency and Conservation Block Grant Program to enhance renewable (PV) programs offered to existing residential customers and new home builders for the installation of solar electric generation systems. This program when implemented will save 3,900,000 kWh per year and reduce carbon emissions by 3,400,000 pounds of CO2 each year, with a lifetime savings of 66,360,000 kWh, avoiding over 26 Thousand metric tons of CO2.

The City of Roseville currently offers an incentive to existing residents that install a solar electric generation system, to help offset the dependency on utility provided energy. There are also incentives offered to new home developers that incorporate solar electric generation systems as a standard feature on production homes.

In spring of 2008 KEMA, Inc. an energy engineering consultant was hired to prepare a 10-year Demand Side Management Plan (DSM) to evaluate our current programs and recommend changes to those programs to increase customer participation. The objective for these grant funds will be to enable the DSM plan for a 3-year period of time by increasing rebate levels, developing customer education programs and expand program participation.⁶³

⁶³ *City of Roseville, California Residential Solar Electric Generation Programs, April 2009, See appendices for full text.*

Action Plan				
A	B	C	D	E
n	n	n	n	n

59- Community Weatherization Assistance Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
59	45.0	808	2011	\$6,750,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

Roseville Electric, the City owned utility, serves 45,439 residential customers. We estimate 23% of the families living in Roseville meet the criteria for low income (1) of which 2500 own their own home. Roseville Electric currently provides a discounted rate to 1538 low income residents. Additionally, we have been able to provide funding for the replacement of 10 year or older refrigerators at no cost to a small number of low-income residents.

Weatherization requests from low income customers are currently referred to Project Go Inc. for government funding from the Home Energy Assistance Program (HEAP), Emergency Crisis Intervention (ECIP) Program and Weatherization Assistance Program (WAP). Due to limited funding, not all low income resident weatherization needs are met.

Many of our low income residents live in neighborhoods built before 1991 and would benefit from insulation, caulking, sealing and appliance replacement. The Department of Energy (2) estimates low income customers can save up to 15% on energy bills with application of these cost effective weatherization measures. Roseville Electric has independently evaluated the possible savings and believes 15% to be a conservative estimate given the possible measures installed.⁶⁴

⁶⁴ City of Roseville, California Weatherization Assistance Program Funding, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	y

60- City Parks Water Efficiency Upgrade Program (Federal Stimulus funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
60	84.1	768	2012	\$2,900,000	\$342,696	\$0	\$0	Grant	NA	NA	\$6,803,908

This project is described in the application for federal stimulus funding and is assumed to be 100% grant funded. The results reflect the reduction of fuel costs associated with the maintenance vehicles. The energy and costs saved from the reduced water consumption is considerable, but has not been quantified. Therefore the cost and energy savings are overly conservative for this measure.

The City of Roseville has 61 park sites in Roseville's water service territory. Many of these park sites have inefficient irrigation systems and use an excessive amount of water to keep the park site usable and aestically pleasing. The City would like to retrofit the existing park sites with a universal Irrigation Management System, or Calsense, to better manage true water needs of the landscape. Funding would also be used to remove high water using rye/blue grass to a more resilient Bermuda grass that would require less applied water. Non-play areas would replace the existing grass with decomposed granite requiring no water.

Implementing these projects would save 13.4 AF of water (or 4,380,000 gallons) and remove 125 vehicles from service saving the city 81,783 gallons of fuel annually.⁶⁵

Location	Size	Cost	Design	Yearly water use
All Park sites		\$2,000000	Install Calsense Irrigation Control System	
Maidu Park-soccer	12 acres turf	\$600,000	Replace 10 acres of grass with Bermuda grass and 2 acres of decomposed granite	1,164,000 gallons
Maidu Park-softball	8 acres turf	\$300,000	Replace 8 acres of turf with Bermuda grass	776,000 gallons
TOTAL		\$2,900,000		gallons

⁶⁵ City of Roseville, California Water Efficiency Upgrade Project, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	y	y	n

61- City Parks Water Efficiency Upgrade Program (City funded)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
61	63.2	768	2010	\$2,900,000	\$293,806	\$0	\$0	City Financed	10	12.8%	\$3,071,349

This is the same as Measure 60 except that it is analyzed as city financed. The results reflect the reduction of fuel costs associated with the maintenance vehicles. The energy and costs saved from the reduced water consumption is considerable, but has not been quantified. Therefore the cost and energy savings are overly conservative for this measure.

The City of Roseville has 61 park sites in Roseville's water service territory. Many of these park sites have inefficient irrigation systems and use an excessive amount of water to keep the park site usable and aestically pleasing. The City would like to retrofit the existing park sites with a universal Irrigation Management System, or Calsense, to better manage true water needs of the landscape. Funding would also be used to remove high water using rye/blue grass to a more resilient Bermuda grass that would require less applied water. Non-play areas would replace the existing grass with decomposed granite requiring no water.

Implementing these projects would save 13.4 AF of water (or 4,380,000 gallons) and remove 125 vehicles from service saving the city 81,783 gallons of fuel annually.⁶⁶

Location	Size	Cost	Design	Yearly water use
All Park sites		\$2,000000	Install Calsense Irrigation Control System	
Maidu Park-soccer	12 acres turf	\$600,000	Replace 10 acres of grass with Bermuda grass and 2 acres of decomposed granite	1,164,000 gallons
Maidu Park-softball	8 acres turf	\$300,000	Replace 8 acres of turf with Bermuda grass	776,000 gallons
TOTAL		\$2,900,000		gallons

⁶⁶ City of Roseville, California Water Efficiency Upgrade Project, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

62- Community Direct Load Control Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
62	36.7	409	2014	\$3,000,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

Roseville Electric implemented a residential direct load management program in September 2007, marketed under the name Power Partners. This voluntary program allows residents to help reduce Roseville's energy use during situations of peak demand. As energy prices drive more decisions in the electricity industry, load management is taking on the increasingly important role of managing risk for utilities. Currently the program is designed to recapture 5 MW of energy demand when activated. Leveraging the existing infrastructure, equipment and service contracts Roseville Electric seeks to expand the system to 15 MW in an effort to more effectively utilize the potential of such a program.

The expansion would require an estimated 10,000 additional switch devices installed over the next five years including services, acquisition and maintenance costs.⁶⁷

⁶⁷ City of Roseville, California Direct Load Control Project, April 2009, See appendices for full text.

Action Plan				
A	B	C	D	E
n	n	n	n	n

63- Community Business Solar Energy Installation Program (Stimulus funded local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Total Capital Cost	Annual Cost Savings	Annual O&M Costs	Component Repl. Cost	Financing	Simple Payback	Internal Rate of Return	Net Present Value
63	45.0	757	2010	\$2,500,000	\$0	\$0	\$0	Grant	NA	NA	\$0

This project is described in the application for federal stimulus funding. It was not included in any of the Action Plans to avoid an over reliance on local carbon offsets.

Roseville Electric proposes to supplement Roseville Electric PV buy down incentives for business customers with economic stimulus funding. We believe that will cause business PV installations in Roseville to at least double between now and 2016. California's Senate Bill 1 requires that all electric utilities reduce PV incentives on average 7% per year through 2016. This means fewer incentive dollars will be available to customers who want to install PV. Potentially, this means few PV systems installed. This will occur when the state and its residents will need to rely more and more on clean and green renewable electric generation. Roseville Electric, the City owned utility, ranks ninth nationally as the most solar installed per capita city in the United States. Roseville Electric, the local electric utility provider is a department of the City of Roseville.⁶⁸

⁶⁸ City of Roseville, California Business Solar Energy (PV) Installation Project, April 2009, See appendices for full text.

The following Traffic Operational Improvements are incorporated as local carbon offsets.

Action Plan				
A	B	C	D	E
y	y	y	y	y

64- Traffic Operational Improvements '04-'05 (local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Net Cap Cost	Annual Cost Savings	Annual O&M Costs	Comp. Repl. Cost	Financing	Simple Payback	IRR	Net Present Value
64	18.0	6,747	2005	\$40,750,000	\$0	\$0	\$0	none	NA	NA	NA

Action Plan				
A	B	C	D	E
y	y	y	y	y

65- Traffic Operational Improvements '06-'07 (local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Net Cap Cost	Annual Cost Savings	Annual O&M Costs	Comp. Repl. Cost	Financing	Simple Payback	IRR	Net Present Value
65	18.0	1,609	2007	\$1,074,727	\$0	\$0	\$0	none	NA	NA	NA

Action Plan				
A	B	C	D	E
y	y	y	y	y

66- Traffic Operational Improvements '08-'09 (local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Net Cap Cost	Annual Cost Savings	Annual O&M Costs	Comp. Repl. Cost	Financing	Simple Payback	IRR	Net Present Value
66	18.0	2,615	2009	\$10,156,225	\$0	\$0	\$0	none	NA	NA	NA

Action Plan				
A	B	C	D	E
n	n	n	n	y

67- Traffic Operational Improvements '10-'12 (local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Net Cap Cost	Annual Cost Savings	Annual O&M Costs	Comp. Repl. Cost	Financing	Simple Payback	IRR	Net Present Value
67	21.3	658	2012	\$16,320,000	\$0	\$0	\$0	Grant	NA	NA	NA

Action Plan				
A	B	C	D	E
n	n	n	n	y

68- Traffic Operational Improvements '13-'15 (local carbon offset)

No.	Evaluation Score	Annual CO2 Reduction (tons)	Impl. Date	Net Cap Cost	Annual Cost Savings	Annual O&M Costs	Comp. Repl. Cost	Financing	Simple Payback	IRR	Net Present Value
68	7.8	37	2014	\$5,800,000	\$0	\$0	\$0	Grant	NA	NA	NA

Completed Projects

- 69- 8.0 kWac Photovoltaic Solar Energy System Fixed Tilt Roseville Aquatic Center
- 70- 18.6 kWac Photovoltaic Solar Energy System Fixed Tilt Fire Station #6
- 71- 10.0 kWac Photovoltaic Solar Energy System Fixed Tilt Middle School
- 72- 10.0 kWac Photovoltaic Solar Energy System Fixed Tilt City Hall
- 73- Lighting Retrofits for Efficiency 13 City Buildings
- 74- Various Building Efficiency Measures Oak St. and Main Library
- 75- Dry Creek Motors Retrofit for Efficiency
- 76- Various Building Efficiency Measures Police Department and Maidu Library
- 77- Corporation Yard Task Lighting;
- 78- Multiple Building Energy Efficiency Measures

7.0 Summary and Conclusions

A greenhouse gas (GHG) emissions reduction of over 20% below 2000 levels by 2015 can be achieved by a number of paths documented in this report. Four paths, or Action Plans, are comprised of up to 26 new individual measures. The plans also include numerous projects completed since 2000 and incorporate the emissions trend into the future based on projected city growth. Each is evaluated for the financial costs and benefits they contribute to the overall strategy. The total “palette” of quantified opportunities includes 68 new measures to reduce energy consumption. The analysis model underpinning these results will be available for incorporating new information and technologies as they come available, as well as refining the analysis with monitored data. This comprehensive approach to addressing emissions reduction allows the City to meet a number of related goals, including improving the long term financial health of Roseville, reducing the budget vulnerability to future energy cost escalation, addressing the existing maintenance demands of aging equipment, and providing public demonstrations of commitment and progress in the highly visible challenge of greenhouse gas emissions reduction.

The information in this report allows the City to understand the challenges and opportunities available in reaching its goal to reduce emissions. The measure evaluation matrix quantifies the many related issues not captured by the financial results or emissions reduction such as public visibility and the resolution of existing problems. The financial results provide information on the investment value of the various paths of action, along with the anticipated net cash flow over time. The ability to understand the complex context of greenhouse gas emissions reduction will allow policy makers to define expected outcomes and associated financial commitments to achieve desired outcomes. This provides city staff the flexibility needed to effectively implement the policy. The individual measures within each plan may be delayed, modified or replaced as appropriate while remaining faithful to the policy directive. This flexibility will be essential given the dynamic nature of the regulatory environment and the rapidly evolving financial and technological opportunities in California.

In summary, this analytical framework and report organizes the city’s data and documentation relating to energy efficiency and greenhouse gas emissions reduction. It is applied to the city objective of reducing greenhouse gas emissions, presenting four strategies to reduce emissions by 20% to 39% below 2000 levels by 2015. The database and analytical framework supporting this work are available into the future as new information and opportunities (technical and financial) emerge for consideration.

8.0

8.0 Appendices

- 8.1 Basis for 2000 GHG Inventory
- 8.2 Basis for 2006 GHG Inventory
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8.1 Basis for 2000 GHG Inventory

City of Roseville Greenhouse Gas Inventory (Based on utility billing information and data received from client) Baseline Year 2000						
	kWh	Therms	Approximate Energy Cost	Gasoline (gals/yr)	Diesel	eCO2 (metric tons)
Buildings						
CITY OF ROSEVILLE AQUATICS	583,567	0	\$62,208			160.1
CITY OF ROSEVILLE AUTO SERVICE	355,440	14,100	\$51,990			176.4
CITY OF ROSEVILLE BLDG MAINT	1,637,823	676,814	\$851,406			4237.7
CITY OF ROSEVILLE CENTRAL PARK POOL	0	0	\$0			0.0
CITY OF ROSEVILLE CFD MUNI 3	0	0	\$0			0.0
CITY OF ROSEVILLE CIVIC CENTER PROJECT	8,414	0	\$897			2.3
CITY OF ROSEVILLE CNTRL STORES	139,840	2,377	\$17,284			51.7
CITY OF ROSEVILLE COMM CNTR	311,680	0	\$33,225			85.5
CITY OF ROSEVILLE CROCKER RANCH LLD	0	0	\$0			0.0
CITY OF ROSEVILLE DIAMOND OAKS	144,917	0	\$15,448			39.8
CITY OF ROSEVILLE DISASTER PLN	455	0	\$49			0.1
CITY OF ROSEVILLE ELECT ADMIN	528,800	0	\$56,370			145.1
CITY OF ROSEVILLE ELECT MAINT	81,440	0	\$8,682			22.3
CITY OF ROSEVILLE ELECTRIC DEPT	0	0	\$0			0.0
CITY OF ROSEVILLE ELECTRIC OPERATIONS CENTER	0	0	\$0			0.0
CITY OF ROSEVILLE ENGINEERING	519	0	\$55			0.1
CITY OF ROSEVILLE ENGINEERING DEPT	0	0	\$0			0.0
CITY OF ROSEVILLE FIDDYMENT RANCH LLD	0	0	\$0			0.0
CITY OF ROSEVILLE FIRE DEPT	4,474	0	\$477			1.2
CITY OF ROSEVILLE FIRE OPER	1,389,520	0	\$148,123			381.2
CITY OF ROSEVILLE FIRE TRNG	41,693	8,215	\$12,659			57.4
CITY OF ROSEVILLE GEN PROJECTS REDEVELOPMENT	0	1,536	\$1,536			8.6
CITY OF ROSEVILLE HIGHLAND RSRV N LLD	0	0	\$0			0.0
CITY OF ROSEVILLE HISTORIC DISTRICT LLD	0	0	\$0			0.0
CITY OF ROSEVILLE IN FILL CFD 4	0	0	\$0			0.0
CITY OF ROSEVILLE INFILL LLD	0	0	\$0			0.0
CITY OF ROSEVILLE LONGMEADOW SUBDIVISION	0	0	\$0			0.0
CITY OF ROSEVILLE MAIDU INTERPRETIVE CENTER	3,480	0	\$371			1.0
CITY OF ROSEVILLE MAIDU LIBRARY	116,280	0	\$12,395			31.9
CITY OF ROSEVILLE MAIN LIBRARY	598,606	1,594	\$65,405			173.1
CITY OF ROSEVILLE NCRSP LLD	6,135	0	\$654			1.7
CITY OF ROSEVILLE NORTH CENTRAL LLC	0	0	\$0			0.0
CITY OF ROSEVILLE NORTH RSVL SERVICE DIST	5,437	0	\$580			1.5
CITY OF ROSEVILLE NW LITE/LANDSCAPE	0	0	\$0			0.0
CITY OF ROSEVILLE NWRSP LLD	1,405	0	\$150			0.4
CITY OF ROSEVILLE OLYMPUS LLD	40,801	0	\$4,349			11.2
CITY OF ROSEVILLE OPER	0	0	\$0			0.0
CITY OF ROSEVILLE PARKS ADMIN	505	2,563	\$2,617			14.5
CITY OF ROSEVILLE PARKS MAINT	721,101	0	\$76,869			197.8
CITY OF ROSEVILLE POLICE	1,414,600	107,176	\$257,972			988.0
CITY OF ROSEVILLE PUB WKS PROJ	20	0	\$2			0.0
CITY OF ROSEVILLE PUBLIC WORKS DEPARTMENT	0	0	\$0			0.0
CITY OF ROSEVILLE REDEVELOPMENT	0	0	\$0			0.0
CITY OF ROSEVILLE SPORTS CNTR	0	0	\$0			0.0
CITY OF ROSEVILLE STONE POINT CFD 4	0	0	\$0			0.0
CITY OF ROSEVILLE STONERIDGE PAR 1 SER DIST	0	17,534	\$17,534			98.1
CITY OF ROSEVILLE STONERIDGE LLD	0	0	\$0			0.0
CITY OF ROSEVILLE STREET ADMIN	512	0	\$55			0.1
CITY OF ROSEVILLE STREET DEPT	0	0	\$0			0.0
CITY OF ROSEVILLE TRANSPORTATION	0	0	\$0			0.0
CITY OF ROSEVILLE VERNON LLD	0	0	\$0			0.0
CITY OF ROSEVILLE WESTPARK SERVICE DISTRICT	0	0	\$0			0.0
CITY OF ROSEVILLE WOODCREEK EAST CFD#2 SD	0	0	\$0			0.0
CITY OF ROSEVILLE WOODCREEK WEST SRV. DIST.	0	0	\$0			0.0
CITY OF ROSEVILLE WOODCRK OAKS	210,903	0	\$22,482			57.9
Undefined	0	21,612	\$21,612			121.0
Total	8,348,367	853,521	\$1,311,082			7067.9

City of Roseville Greenhouse Gas Inventory (Based on utility billing information and data received from client) Baseline Year 2000						
	kWh	Therms	Approximate Energy Cost	Gasoline (gals/yr)	Diesel	eCO2 (metric tons)
Streetlights						
CITY OF ROSEVILLE STREETLIGHTS	5,042,236	0	\$537,502			1383.3
CITY OF ROSEVILLE TRAFFIC SIG	2,708,282	0	\$288,703			743.0
Total	7,750,518	0	\$621,307			2126
Water/Sewer						
CITY OF ROSEVILLE EU-WATER DIVISION	0	0	\$0			0.0
CITY OF ROSEVILLE RECYCLED WATER UTILITY	0	1,631	\$1,631			9.1
CITY OF ROSEVILLE WATER DIST	88,880	0	\$9,475			24.4
CITY OF ROSEVILLE WATER PROD	252,320	0	\$26,897			69.2
CITY OF ROSEVILLE WTR TRTMNT	734	155,772	\$155,850			872.1
CITY OF ROSEVILLE WW COLLECTNS	49,846	0	\$5,314			13.7
CITY OF ROSEVILLE WWTP	11,804,467	0	\$1,258,356			3238.6
Total	12,196,247	157,403	\$1,096,059			4227
Transit						
Nat Gas Vehicles		141,589				793
Gasoline				2,239		21
Diesel					79,105	752
Total	0	141,589	\$0	2,239	79,105	1566
Commute						
Gasoline			219,245			2059
Diesel					9,280	88
Total			219,245	9,280		2148
Fleet						
Nat Gas Vehicles	516		\$516			3
Gasoline			\$699,550	227,127		2134
Diesel			\$800,843		260,014	2473
Electric	13,500		\$1,439			
Total	13,500	516	\$771,500	227,127	260,014	4607
Waste						
WPWMA						1229
Total						1229
Grand Total	28,308,632	1,011,440	\$3,799,948	446,371	269,294	22,971

8.2 Basis for 2006 GHG Inventory

City of Roseville Greenhouse Gas Inventory (Based on utility billing information and data received from client) Baseline Year 2006						
	kWh	Therms	Approximate Energy Cost	Gasoline (gals/yr)	Diesel	eCO2 (metric tons)
Buildings						
CITY OF ROSEVILLE AQUATICS	669,119	0	71,328			183.6
CITY OF ROSEVILLE AUTO SERVICE	560,534	14,100	73,853			232.7
CITY OF ROSEVILLE BLDG MAINT	2,273,873	676,814	919,209			4412.2
CITY OF ROSEVILLE CENTRAL PARK POOL	0	0	0			0.0
CITY OF ROSEVILLE CFD MUNI 3	0	0	0			0.0
CITY OF ROSEVILLE CIVIC CENTER PROJECT	9,221	0	983			2.5
CITY OF ROSEVILLE CNTRL STORES	164,320	2,377	19,894			58.4
CITY OF ROSEVILLE COMM CNTR	351,840	0	37,506			96.5
CITY OF ROSEVILLE CROCKER RANCH LLD	1,919	0	205			0.5
CITY OF ROSEVILLE DIAMOND OAKS	252,320	0	26,897			69.2
CITY OF ROSEVILLE DISASTER PLN	504	0	54			0.1
CITY OF ROSEVILLE ELECT ADMIN	609,760	0	65,000			167.3
CITY OF ROSEVILLE ELECT MAINT	68,480	0	7,300			18.8
CITY OF ROSEVILLE ELECTRIC DEPT	3,281	0	350			0.9
CITY OF ROSEVILLE ELECTRIC OPERATIONS CENTER	0	0	0			0.0
CITY OF ROSEVILLE ENGINEERING	8,949	0	954			2.5
CITY OF ROSEVILLE ENGINEERING DEPT	0	0	0			0.0
CITY OF ROSEVILLE FIDDYMENT RANCH LLD	0	0	0			0.0
CITY OF ROSEVILLE FIRE DEPT	0	0	0			0.0
CITY OF ROSEVILLE FIRE OPER	1,487,555	0	158,573			408.1
CITY OF ROSEVILLE FIRE TRNG	68,747	8,215	15,543			64.8
CITY OF ROSEVILLE GEN PROJECTS REDEVELOPMENT	0	1,536	1,536			8.6
CITY OF ROSEVILLE HIGHLAND RSRV N LLD	4,354	0	464			1.2
CITY OF ROSEVILLE HISTORIC DISTRICT LLD	0	0	0			0.0
CITY OF ROSEVILLE IN FILL CFD 4	0	0	0			0.0
CITY OF ROSEVILLE INFILL LLD	9	0	1			0.0
CITY OF ROSEVILLE LONGMEADOW SUBDIVISION	147	0	16			0.0
CITY OF ROSEVILLE MAIDU INTERPRETIVE CENTER	67,600	0	7,206			18.5
CITY OF ROSEVILLE MAIDU LIBRARY	158,640	0	16,911			43.5
CITY OF ROSEVILLE MAIN LIBRARY	684,556	1,594	74,568			196.7
CITY OF ROSEVILLE NCRSP LLD	8,203	0	874			2.3
CITY OF ROSEVILLE NORTH CENTRAL LLC	109	0	12			0.0
CITY OF ROSEVILLE NORTH RSVL SERVICE DIST	33,534	0	3,575			9.2
CITY OF ROSEVILLE NW LITE/LANDSCAPE	201	0	21			0.1
CITY OF ROSEVILLE NWRSP LLD	12,337	0	1,315			3.4
CITY OF ROSEVILLE OLYMPUS LLD	41,654	0	4,440			11.4
CITY OF ROSEVILLE OPER	68,240	0	7,274			18.7
CITY OF ROSEVILLE PARKS ADMIN	0	2,563	2,563			14.3
CITY OF ROSEVILLE PARKS MAINT	1,011,117	0	107,785			277.4
CITY OF ROSEVILLE POLICE	1,663,000	107,176	284,452			1056.2
CITY OF ROSEVILLE PUB WKS PROJ	0	0	0			0.0
CITY OF ROSEVILLE PUBLIC WORKS DEPARTMENT	0	0	0			0.0
CITY OF ROSEVILLE REDEVELOPMENT	4,760	0	507			1.3
CITY OF ROSEVILLE SPORTS CNTR	254,880	0	27,170			69.9
CITY OF ROSEVILLE STONE POINT CFD 4	0	0	0			0.0
CITY OF ROSEVILLE STONERIDGE PAR 1 SER DIST	0	17,534	17,534			98.1
CITY OF ROSEVILLE STONERIDGE LLD	27,626	0	2,945			7.6
CITY OF ROSEVILLE STREET ADMIN	523	0	56			0.1
CITY OF ROSEVILLE STREET DEPT	487	0	52			0.1
CITY OF ROSEVILLE TRANSPORTATION	20,121	0	2,145			5.5
CITY OF ROSEVILLE VERNON LLD	3,429	0	366			0.9
CITY OF ROSEVILLE WESTPARK SERVICE DISTRICT	0	0	0			0.0
CITY OF ROSEVILLE WOODCREEK EAST CFD#2 SD	1,265	0	135			0.3
CITY OF ROSEVILLE WOODCREEK WEST SRV. DIST.	1,108	0	118			0.3
CITY OF ROSEVILLE WOODCRK OAKS	236,801	0	25,243			65.0
Undefined	0	21,612	21,612			121.0
Total	10,835,123	853,521	\$1,870,407			7750.1

GHG Reduction Action Plan Analysis

City of Roseville Greenhouse Gas Inventory (Based on utility billing information and data received from client) Baseline Year 2006						
	kWh	Therms	Approximate Energy Cost	Gasoline (gals/yr)	Diesel	eCO2 (metric tons)
Streetlights						
CITY OF ROSEVILLE STREETLIGHTS	6,619,251	0	705,612			1816.0
CITY OF ROSEVILLE TRAFFIC SIG	730,212	0	77,841			200.3
Total	7,349,463	0	\$729,571			2016
Water/Sewer						
CITY OF ROSEVILLE EU-WATER DIVISION	0	0	0			0.0
CITY OF ROSEVILLE RECYCLED WATER UTILITY	158,320	1,631	18,508			52.6
CITY OF ROSEVILLE WATER DIST	5,299	0	565			1.5
CITY OF ROSEVILLE WATER PROD	650,920	0	69,388			178.6
CITY OF ROSEVILLE WTR TRTMNT	5,709	155,772	156,381			873.5
CITY OF ROSEVILLE WW COLLECTNS	232,694	0	24,805			63.8
CITY OF ROSEVILLE WWTP	22,145,924	0	2,360,755			6075.7
Total	23,198,866	157,403	\$2,449,496			7246
Transit						
Nat Gas Vehicles		141,589				793
Gasoline				2,239		21
Diesel					79,105	752
Total	0	141,589	0	2,239	79,105	1566
Commute						
Gasoline			310,701			2919
Diesel				13,151		125
Total			310,701	13,151		3044
Fleet						
Nat Gas Vehicles		108	108			1
Gasoline			862,698	280,097		2631
Diesel			1,093,446		355,015	3377
Electric	47,250		5,037			
Total	47,250	108	1,660,472	280,097	355,015	6008
Waste						
WPWMA						1229
Total						1229
Grand Total	41,430,702	1,011,032	6,709,946	590,798	368,166	28,858

8.3 General Inputs and Assumptions

Metric	Report Base year:	2008	Baseline year:	2000	Results Year	2015				
		Year	Power Mix Coefficient	lbs/kWh	Year	Vehicle Gasoline CO2e	lbs/gal	Year	Vehicle Diesel CO2e Coefficient	lbs/gal
Term of Analysis (yrs)	Values Used in Analysis	1990	0.605	Assumed constant based on Average 2000 to 2008	1990	20.709	Assumed constant from 1990 to 2008	1990	20.968	Assumed constant from 1990 to 2008
Term of Financing (yrs)	25	1991	0.605		1991	20.709		1991	20.968	
Discount Rate	10	1992	0.605		1992	20.709		1992	20.968	
kWh Energy Cost Escalation Rate	5.00%	1993	0.605		1993	20.709		1993	20.968	
Nat Gas Energy Cost Escalation Rate	3.50%	1994	0.605		1994	20.709		1994	20.968	
Vehicle Fuel Cost Inflation Rate	3.50%	1995	0.605		1995	20.709		1995	20.968	
Energy Cost (\$/kWh)	8.00%	1996	0.605		1996	20.709		1996	20.968	
Energy Cost (\$/Therm)	\$0.107	1997	0.605		1997	20.709		1997	20.968	
Interest Rate	1.000	1998	0.605		1998	20.709		1998	20.968	
Inflation Rate	3.95%	1999	0.605		1999	20.709		1999	20.968	
Conversions	3.00%	2000	0.495		2000	20.709		2000	20.968	
CO2/kWh (lbs.)	0.605	2001	0.622		2001	20.709		2001	20.968	
CO2/Therm (#/Therm)	12.34	2002	0.486		2002	20.709		2002	20.968	
CO2e Gasoline (lbs/gal)	20.7	2003	0.520		2003	20.709		2003	20.968	
CO2e Diesel (lbs/gal)	21.0	2004	0.604		2004	20.709		2004	20.968	
BioDiesel (lbs/gal)	5.242 (recycled stock)	2005	0.660		2005	20.709		2005	20.968	
Ethanol (lbs/gal)	12.23 100% ethanol	2006	0.573		2006	20.709		2006	20.968	
\$/gal Gasoline	\$3.08	2007	0.730		2007	20.709		2007	20.968	
\$/gal Diesel	\$3.08	2008	0.753		2008	20.709		2008	20.968	
\$/gal Biodiesel	\$3.39	2009	0.768	Provided by Roseville Electric	2009	20.536	Assumed Linear	2009	20.793	Assumed Linear
\$/gal Ethanol (equivalent gallon)	\$4.00	2010	0.694		2010	20.364		2010	20.619	
\$/Therm CNG Vehicles	\$1.00	2011	0.685		2011	20.191		2011	20.444	
\$/kWh Electric Vehicles	\$0.107	2012	0.683		2012	20.019		2012	20.269	
Electric Vehicle Mileage	0.30 kWh/mile mid size	2013	0.679		2013	19.846		2013	20.094	
Electric Vehicle Mileage	0.20 kWh/mile subcompact	2014	0.672		2014	19.674		2014	19.920	
PPA Initial % Increase over Utility kWh	10.00%	2015	0.669		2015	19.501		2015	19.745	
PPA Energy Cost Escalation Rate	5.00%	2016	0.663		2016	19.328		2016	19.570	
Additional Factors	2017	0.658	2017		19.156	2017		19.395		
TOU Factor	1	2018	0.653		2018	18.983		2018	19.221	
CNG conversion cost	\$5,000	2019	0.647		2019	18.811		2019	19.046	
CNG Equipment	\$150,000	2020	0.642		2020	18.638		2020	18.871	
Job Creation: Jobs/\$1m	17.00	2021	0.637	Assumed constant average projected reduction from 2011 to 2017	2021	18.638	Assumed Constant from 2020 to 2035	2021	18.871	Assumed Constant from 2020 to 2035
GHG Units (short or metric tons)	metric	2022	0.633		2022	18.638		2022	18.871	
Conversion to tons (short or MMT)	2204.60	2023	0.628		2023	18.638		2023	18.871	
Fleet and Employee Policy Limiting Expansion	yes	2024	0.623		2024	18.638		2024	18.871	
		2025	0.618		2025	18.638		2025	18.871	
		2026	0.613		2026	18.638		2026	18.871	
		2027	0.608		2027	18.638		2027	18.871	
		2028	0.604		2028	18.638		2028	18.871	
		2029	0.599		2029	18.638		2029	18.871	
		2030	0.594		2030	18.638		2030	18.871	
		2031	0.590		2031	18.638		2031	18.871	
		2032	0.585		2032	18.638		2032	18.871	
		2033	0.581		2033	18.638		2033	18.871	
		2034	0.576		2034	18.638		2034	18.871	
		2035	0.572		2035	18.638		2035	18.871	

Table 21: Analysis General Assumptions

8.4 Roseville Electric Power Content (actual and projected)

The power content values for 2000 to 2017 were provided by Roseville Electric. The values prior to 2000 are based on the average value from 2000 to 2008. The values after 2017 are based on the constant average projected reduction from 2011 to 2017.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Power Content (lbs CO2e/kWh)	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Power Content (lbs CO2e/kWh)	0.495	0.622	0.486	0.520	0.604	0.660	0.573	0.730	0.753	0.768
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Power Content (lbs CO2e/kWh)	0.694	0.685	0.683	0.679	0.672	0.669	0.663	0.658	0.653	0.647
Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Power Content (lbs CO2e/kWh)	0.642	0.637	0.633	0.628	0.623	0.618	0.613	0.608	0.604	0.599
Year	2030	2031	2032	2033	2034	2035				
Power Content (lbs CO2e/kWh)	0.594	0.590	0.585	0.581	0.576	0.572				

Table 22: Power Content Values for Converting kWh to lbs/CO2e

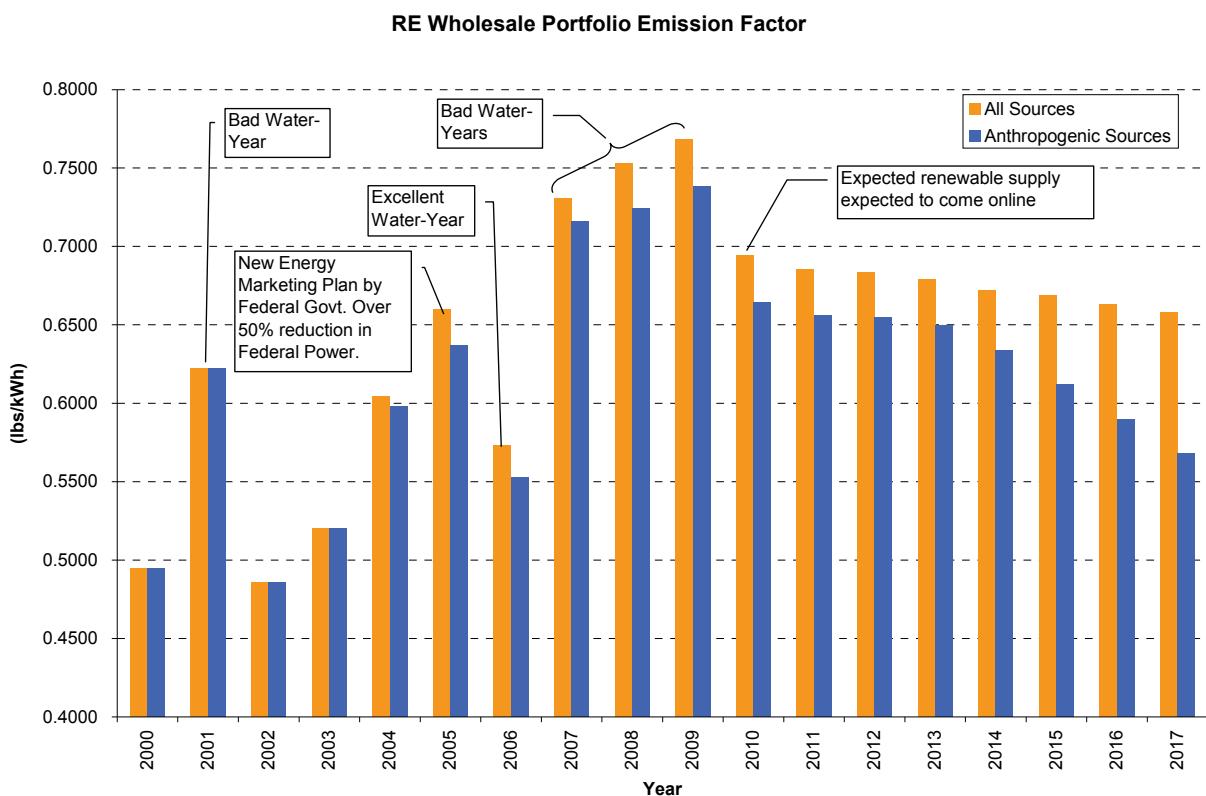


Figure 16: Roseville Electric Wholesale Portfolio Emission Factor⁶⁹

⁶⁹ *PortfolioEmissionFactor_v01 090108*, provided by Roseville Electric Staff

8.5 City of Roseville Population Trend 2000 to 2020

The population values below used in the analysis reflect the information in the current General Plan. The additional emissions associated with the projected population growth from 2009 to 2015 will have a significant impact on the total greenhouse gas emissions for the city.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Population	79,921	83,097	86,398	89,831	93,401	97,112	100,971	104,983	109,154	112,361
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Population	115,662	119,060	122,558	126,158	129,865	133,680	133,903	134,125	134,349	134,572
Year	2020	2021	2022	2023	2024	2025				
Population	134,796	135,021	135,245	135,471	135,696	135,922				

8.6 Action Plan Evaluations

The GHG Emission Reduction Action Plans involve more than CO2e reduction and cash flow. There are critical concerns that should be factored into the decision making process. These include the financial metrics of internal rate of return (IRR) and net present value (NPV) used to evaluate the worthiness of the investment; the cost of implementing the measure, some measures come with a large price tag which will challenge liquidity; the degree to which the plan resolves existing problems, such as old, high maintenance air conditioning units; the visibility of the measures to the public, for example the photovoltaic systems are a physical example of actions taken the City and communicate action and commitment to the community. Other key considerations include the employee impacts of new equipment or procedures, which may generate internal opposition; and the impact on the variability of future energy costs and the associated budgetary vulnerability.

Each measure and the plans as a whole are evaluated by the following considerations:

- Measure Capital Cost:
- Financial Metrics (IRR and NPV)
- Resolution of Existing Problems
- GHG Impact
- Positive Public Visibility
- Employee Impact
- Community Impact
- Energy Security (Energy Cost Stabilization)
- Job Creation
- Ease and Probability of Implementation

Table 23 below provides the evaluation results for each measure by individual criteria. The individual scores for each category (cost, financial metrics, etc) are summed to provide an overall score for that measure. While this table provides important information to be considered when selecting measures, the scores are advisory only. A relatively low score does not preclude a measure, nor should a high score guarantee inclusion of the measure in the Action Plans. There will always be additional considerations that are not reflected in the Selection Evaluation process. The “adjusted measure score” reflects the relative weighting of the evaluation criteria as presented in Table 23 below.

Cost (relative)	Financial Metrics (relative)	Resolution of Problems (cumulative) 0-6	GHG Impact (cumulative)	Positive Public Visibility (cumulative) 0-6	Employee Impact (relative) -3 to 3	Community Impact (relative)	Energy Security (cumulative)	Job Creation (Cumulative)	Ease of Implementation (relative)	total=30
1	5	1	3	5	5	1	5	1	3	30

Table 23: Evaluation Criteria Weighting⁷⁰

⁷⁰ total allocation = 3 x number of criteria = 3 x 10 = 30, average score = 3

GHG Reduction Action Plan Analysis

Measure Number	Measure Name	Cost relative: -3.0 to 3.0	Financial Metrics (relative)	Resolution of Problem cumulative: 0.0 to 6.0	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Security (cumulative)	Job Creation (Cumulative)	Ease of Implementation (relative)	Measure Score	Adjusted Measure Score
4	City Facilities Energy Efficiency (Federal Stimulus funded)	3.0	3.0	4.00	6.0	3.00	1.00	3.00	6.0	1.0	0.0	29.00	93.00
5	Streetlighting HID to LED (Federal Stimulus Funded)	3.0	3.0	2.00	6.0	4.0	1.0	0.0	4.7	5.1	0.0	23.66	86.30
3	City Facilities Energy Efficiency (City funded)	0.6	2.1	4.00	6.0	2.0	1.0	0.0	6.0	1.0	1.0	21.75	78.34
60	Water Efficiency Upgrade Project-retrofit of parks (Stimulus funded)	3.0	3.0	4.00	5.6	3.00	0.00	3.00	4.0	1.5	0.0	25.57	76.73
48	PV 1.74 MW DC (Fixed Tilt)- Brownfield Site (Stimulus funded)	3.0	3.0	0.00	4.6	6.00	0.00	0.00	2.0	5.8	2.0	18.60	71.81
19	Fleet Replacement Strategy B	-3.0	1.8	0.00	6.0	4.00	-1.00	0.00	6.0	2.6	1.0	13.85	69.23
47	PV 1.0 MW DC (Single Axis)- Rsville Energy Park (Stimulus funded)	3.0	3.0	0.00	3.0	6.00	0.00	0.00	1.4	3.3	2.0	16.39	63.88
61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	-0.5	1.7	2.00	5.6	3.00	1.00	0.00	3.4	1.5	2.0	16.21	63.85
38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	3.0	3.0	0.00	1.8	6.00	0.00	0.00	0.8	2.3	2.0	14.59	57.35
46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	3.0	3.0	0.00	1.3	6.00	0.00	0.00	0.7	1.8	2.0	13.97	55.24
18	Fleet Replacement Strategy A	2.5	2.4	0.00	3.8	4.00	-1.00	0.00	2.5	0.2	1.0	14.21	53.41
13	Grease to Gas Dry Creek WWTP (requires CoGen) (Grant Funded)	3.0	3.0	5.00	0.0	1.00	2.00	2.00	2.4	1.7	0.0	18.42	52.08
44	PV 305 kW DC (Fixed Tilt)- Corp Yard Prkng Area (Stimulus Funded)	3.0	3.0	0.00	0.7	6.00	0.00	0.00	0.4	1.0	2.0	13.09	52.01
42	PV 230 kW DC (Fixed Tilt)- Mahany Park Prkng Area (Stimulus Funded)	3.0	3.0	0.00	0.6	6.00	0.00	0.00	0.3	0.8	2.0	12.87	51.15
50	PV (4.7 MW DC Fixed Tilt) PPA	2.9	-3.0	0.00	6.0	6.00	0.00	0.00	3.0	6.0	-2.0	14.94	50.94
40	PV 160 kW DC (Fixed Tilt)- Dwntwn Prkng (Stimulus Funded)	3.0	3.0	0.00	0.4	6.00	0.00	0.00	0.2	0.5	2.0	12.61	50.19
15	Transit Bus Replacement Strategy A	2.6	2.4	0.00	0.9	4.0	0.0	0.0	2.3	0.2	1.0	12.22	48.99
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	3.0	3.0	0.00	0.2	6.00	0.00	0.00	0.1	0.2	0.0	12.26	48.91
11	Pleasant Grove WWTP CoGen (540 kW Engine)	-1.3	1.7	0.00	6.0	0.0	0.0	0.0	4.2	1.9	1.0	10.62	46.22
16	Transit Bus Replacement Strategy B	2.3	1.9	0.00	1.2	4.00	0.00	0.00	1.5	0.3	1.0	10.91	42.89
8	Streetlighting Reduce Residential Lumins (50%)	2.5	1.7	0.00	6.0	3.0	-1.0	-1.5	0.7	0.2	0.0	11.38	41.01
14	Co Gen Linked to Dry Creek Grease to Gas	-2.4	1.8	0.00	6.0	0.0	0.0	0.0	3.3	2.4	1.0	8.71	40.97
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	-1.2	1.6	5.00	0.0	1.0	2.0	2.0	2.4	1.7	1.0	12.87	40.95
53	Non-Residential On-site audits (local offset)	3.0	0.0	0.00	6.0	3.00	0.00	3.00	0.0	0.3	0.0	15.00	39.00
54	Residential and Commercial E E and Solar Loan funding (local offset)	3.0	0.0	0.00	6.0	3.00	0.00	3.00	0.0	5.1	0.0	15.00	39.00
57	Residential audit and E E upgrades program (local offset)	3.0	0.0	0.00	6.0	3.00	0.00	3.00	0.0	2.6	0.0	15.00	39.00
63	Business Solar Energy Installation (local offset)	3.0	0.0	0.00	6.0	3.00	0.00	3.00	0.0	1.3	0.0	15.00	39.00
10	Streetlighting Residential Darken 1st 50% of Fixtures	2.7	2.1	0.00	6.0	3.0	-2.0	-1.5	0.8	0.1	-1.0	11.14	38.79
59	Weatherization Assistance (local offset)	3.0	0.0	0.00	5.9	3.00	0.00	3.00	0.0	3.4	0.0	14.86	38.58
17	Fleet Management Software Eff. Initiatives	3.0	0.0	3.00	1.2	4.00	1.00	0.00	0.7	0.0	3.0	12.91	38.05
58	Residential Solar Electric Generation programs (local offset)	3.0	0.0	0.00	5.3	3.00	0.00	3.00	0.0	3.7	0.0	14.30	36.89
9	Streetlighting Residential Darken 2nd 50% of Fixtures	2.7	1.8	0.00	6.0	3.0	-2.0	-1.5	0.5	0.1	-1.0	10.56	35.88
56	Residential New Construction M&V Programs (local offset)	3.0	0.0	0.00	4.9	3.00	0.00	3.00	0.0	1.9	0.0	13.86	35.57
2	Building Solar Thermal (PPA funded)	3.0	-0.5	0.00	0.6	6.00	0.00	0.00	0.0	0.1	3.0	9.07	32.14
62	Direct Load Control Project (local offset)	3.0	0.0	0.00	3.0	3.00	0.00	3.00	0.0	1.5	0.0	11.96	29.88
51	Energy Efficient Appliance Rebate Program (local offset)	3.0	0.0	0.00	2.2	3.00	0.00	3.00	0.0	0.3	0.0	11.17	27.52
37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	-2.3	-3.0	0.00	1.6	6.00	0.00	0.00	1.6	2.3	2.0	3.91	25.53
52	HVAC Maintenance Energy Efficient Program (local offset)	3.0	0.0	0.00	0.6	3.00	0.00	3.00	0.0	0.5	0.0	9.62	22.86
55	Residential Duct Testing and Sealing (local offset)	3.0	0.0	0.00	0.6	3.00	0.00	3.00	0.0	3.8	0.0	9.62	22.85

Table 24: Measure List and Evaluations A

GHG Reduction Action Plan Analysis

Measure Number	Measure Name	Cost relative: -3.0 to 3.0	Financial Metrics (relative)	Resolution of Problem cumulative: 0.0 to 6.0	GHG Impact (cumulative)	Positive Public Visibility (cumulative)	Employee Impact (relative)	Community Impact (relative)	Energy Security (cumulative)	Job Creation (Cumulative)	Ease of Implementation (relative)	Measure Score	Adjusted Measure Score
34	PV 500 kW DC (unspecified location) PPA	3.0	-3.0	0.00	1.3	6.00	0.00	0.00	0.0	1.7	2.0	7.32	21.95
45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	2.9	-3.0	0.00	1.3	6.00	0.00	0.00	0.0	1.8	2.0	7.25	21.87
36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	2.9	-3.0	0.00	1.1	6.00	0.00	0.00	0.0	1.4	2.0	7.07	21.33
67	Traffic Operational Improvements '10-'12 (Offset)	3.0	0.0	4.00	4.8	0.00	0.00	3.00	0.0	6.0	2.0	14.77	24.31
35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	0.7	-3.0	0.00	0.9	6.00	0.00	0.00	0.4	1.0	2.0	4.98	20.43
49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	2.9	-3.0	0.00	0.8	6.00	0.00	0.00	0.0	1.1	2.0	6.69	20.19
43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	2.9	-3.0	0.00	0.7	6.00	0.00	0.00	0.0	1.0	2.0	6.66	20.09
41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	2.9	-3.0	0.00	0.5	6.00	0.00	0.00	0.0	0.8	2.0	6.49	19.58
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	2.9	-3.0	0.00	0.4	6.00	0.00	0.00	0.0	0.6	2.0	6.32	19.07
6	Streetlighting HID to LED 40% Fixtures	-1.5	-3.0	2.00	1.9	4.0	1.0	0.0	0.4	6.0	1.0	4.89	18.40
7	Streetlighting HID to LED 40% Fixtures	-1.5	-3.0	2.00	1.9	4.0	1.0	0.0	0.4	6.0	1.0	4.89	18.40
23	Biodiesel 99%	2.9	-3.0	0.00	6.0	3.00	-1.00	1.00	0.0	0.0	-3.0	8.94	16.94
22	Biodiesel 50%	2.9	-3.0	0.00	6.0	2.00	-1.00	1.00	0.0	0.0	1.0	7.94	11.94
30	Commute Program Enhancement A	3.0	-3.0	1.00	1.3	1.00	2.00	0.00	0.0	0.0	3.0	5.28	7.84
31	Commute Program Enhancement B	3.0	-3.0	1.00	1.3	1.00	2.00	0.00	0.0	0.0	3.0	5.28	7.84
68	Traffic Operational Improvements '13-'15 (Offset)	3.0	0.0	4.00	0.3	0.00	0.00	3.00	0.0	3.0	2.0	10.27	10.80
26	Biodiesel 50% linked to Fleet A	2.9	-3.0	0.00	6.0	1.00	-1.00	1.00	0.0	0.0	1.0	6.94	6.94
28	Biodiesel 99% Linked to Fleet A	2.9	-3.0	0.00	6.0	1.00	-1.00	1.00	0.0	0.0	-3.00	6.94	6.94
29	Biodiesel 99% Linked to Fleet B	2.9	-3.0	0.00	6.0	1.00	-1.00	1.00	0.0	0.0	-3.00	6.94	6.94
21	Biodiesel 20%	3.0	-3.0	0.00	3.5	1.00	0.00	1.00	0.0	0.0	3.0	5.50	4.49
27	Biodiesel 50% Linked to Fleet B	2.9	-3.0	0.00	4.5	1.00	-1.00	1.00	0.0	0.0	1.00	5.48	2.57
24	Biodiesel 20% linked to Fleet A	3.0	-3.0	0.00	3.5	1.00	-1.00	1.00	0.0	0.0	3.0	4.50	-0.51
25	Biodiesel 20% Linked to Fleet B	3.0	-3.0	0.00	1.8	1.00	-1.00	1.00	0.0	0.0	3.0	2.82	-5.55
32	Staff Efficiency Engineer	3.0	-3.0	1.00	0.0	0.00	1.00	0.00	0.0	0.1	0.0	2.00	-6.00
33	Staff Efficiency Coordinator	3.0	-3.0	1.00	0.0	0.00	1.00	0.00	0.0	0.0	1.00	2.00	-6.00
20	Biodiesel 5%	3.0	-3.0	0.00	0.9	0.00	0.00	0.00	0.0	0.0	3.0	0.87	-9.38
70	PV 18.6 kW AC Fire Station #6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
71	PV 10 kW AC Middle School	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
72	PV 10 kW AC City Hall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
69	PV 8 kW AC RSVL Aquatic CTR (predates analysis)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
64	Traffic Operational Improvements '04-'05 (Offset)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
65	Traffic Operational Improvements '06-'07 (Offset)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
66	Traffic Operational Improvements '08-'09 (Offset)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
73	City Various Buildings - Lighting: 13 Locations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
74	Various - Vending Miser and Chiller: Oak St. and Main Library	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
75	Dry Creek Motors	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
76	Police Department and Maidu Library	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
77	Corp Yard Task Lighting	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed
78	Multiple Building Energy Efficiency Measures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Completed

Table 25: Measure List and Evaluations B

The table below compiles the scoring for each measure included in each plan and yields a relative score for each metric. As with the previous table, a higher score indicate more a more favorable evaluation for that metric or plan. Plan D, for example scores high on “Public Visibility” but scores lowest on “Financial Metrics” and scores below Plans D and E overall. The category weighting has been integrated into these numbers as well as an integration factor to allow the aggregation of the relative and comprehensive values.⁷¹

Evaluation Scoring					
Metric \ Plan	A	B	C	D	E
Cost	0.0	28.9	29.8	30.3	61.4
Financial Metrics	0.0	-77.4	-35.5	-104.2	63.5
Resolution of Existing Problems	0.0	1.6	2.6	3.3	4.8
GHG Impact	0.0	19.5	22.4	23.9	31.1
Public Visibility	0.0	58.2	52.6	61.4	68.6
Employee Impact	0.0	2.4	4.8	8.0	7.2
Community Impact	0.0	3.0	1.5	3.0	15.0
Energy Security	0.0	20.6	22.5	22.6	30.3
Job Creation	0.0	3.6	2.7	4.8	6.5
Ease of Implementation	0.0	81.0	99.0	96.0	90.0
Total	0.0	141.4	202.4	149.2	378.4

Table 26: Plan Evaluation Results

This analysis is intended to provide an overview of the effectiveness of each plan. While it should encourage a more comprehensive review of the cost/benefits of each strategy, these quantitative results are based on subjective judgments and are advisory only. They should be only one consideration in the selection of the most appropriate plan for the City of Roseville.

⁷¹ Calculation note: A factor of 0.16 was applied to the results of the “cumulative” metrics to equalize the scale of results for the two types of scoring (relative and cumulative).

8.7 Measure List with Funding Strategy

The following pages provide additional information for each measure where appropriate. The list below identifies the funding methodology utilized for each measure.⁷²

No.	Measure Name	Funding
1	Roseville Aquatic Center Solar Thermal (Federal Stimulus Funded)	Federal Stimulus Funded
2	Building Solar Thermal (PPA funded)	PPA
3	City Facilities Energy Efficiency (City funded)	City Financed
4	City Facilities Energy Efficiency (Federal Stimulus funded)	Federal Stimulus Funded
5	Streetlighting HID to LED (Federal Stimulus Funded)	Federal Stimulus Funded
6	Streetlighting HID to LED 40% Fixtures	City Financed
7	Streetlighting HID to LED 40% Fixtures	City Financed
8	Streetlighting Reduce Residential Lumins (50%)	City Financed
9	Streetlighting Residential Darken 2nd 50% of Fixtures	City Funded
10	Streetlighting Residential Darken 1st 50% of Fixtures	City Funded
11	Pleasant Grove WWTP CoGen (540 kW Engine)	City Financed
12	Grease to Gas Dry Creek WWTP (requires CoGen) (City Funded)	City Financed
13	Grease to Gas Dry Creek WWTP (requires CoGen) (Grant Funded)	Federal Stimulus Funded
14	Co Gen Linked to Dry Creek Grease to Gas	City Financed
15	Transit Bus A	City Financed
16	Transit Bus B	City Financed
17	Fleet Management Software Eff. Initiatives	City Funded
18	Fleet New A	City Financed
19	Fleet New B	City Financed
20	Biodiesel 5%	City Funded
21	Biodiesel 20%	City Funded
22	Biodiesel 50%	City Funded
23	Biodiesel 99%	City Funded
24	Biodiesel 20% linked to Fleet A	City Funded
25	Biodiesel 20% Linked to Fleet B	City Funded
26	Biodiesel 50% linked to Fleet A	City Funded
27	Biodiesel 50% Linked to Fleet B	City Funded
28	Biodiesel 99% Linked to Fleet A	City Funded
29	Biodiesel 99% Linked to Fleet B	City Funded
30	Commute Program Enhancement A	City Funded
31	Commute Program Enhancement B	City Funded
32	Staff Efficiency Engineer	City Funded
33	Staff Efficiency Coordinator	City Funded

⁷² The information for each of the Federal Stimulus measures is included in the appendices.

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No.	Measure Name	Funding
34	PV 500 kW DC (unspecified location) PPA	PPA
35	PV 300 kW DC (Single Axis)- Dry Creek Plant (City funded)	City Financed
36	PV 418 kW DC (Single Axis)- Pleasant Grove Plant (City funded)	PPA
37	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (City funded)	City Financed
38	PV 683 kW DC (Fixed Tilt)- Barton Road Plant TOU (Stimulus Funded)	Federal Stimulus Funded
39	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area PPA	PPA
40	PV 160 kW DC (Fixed Tilt)- Downtown Parking Area (Stimulus Funded)	Federal Stimulus Funded
41	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area PPA	PPA
42	PV 230 kW DC (Fixed Tilt)- Mahany Park Parking Area (Stimulus Funded)	Federal Stimulus Funded
43	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area PPA	PPA
44	PV 305 kW DC (Fixed Tilt)- Corp Yard Parking Area (Stimulus Funded)	Federal Stimulus Funded
45	PV 550 kW DC (Fixed Tilt)- Assorted City PPA	PPA
46	PV 550 kW DC (Fixed Tilt)- Assorted City (Stimulus Funded)	Federal Stimulus Funded
47	PV 1.0 MW DC (Single Axis)- Roseville Energy Park (Stimulus funded)	Federal Stimulus Funded
48	PV 1.74 MW DC (Fixed Tilt)- Brownfield Site (Stimulus funded)	Federal Stimulus Funded
49	PV 320 kW DC (Fixed Tilt) Electric Vehicles (New Fleet B) PPA	PPA
50	PV (4.7 MW DC Fixed Tilt) PPA	PPA
51	Energy Efficient Appliance Rebate Program (local offset)	Federal Stimulus Funded
52	HVAC Maintenance Energy Efficiency Program (local offset)	Federal Stimulus Funded
53	Non-Residential On-site audits (local offset)	Federal Stimulus Funded
54	Residential and Commercial EE and Solar Loan funding (local offset)	Federal Stimulus Funded
55	Residential Duct Testing and Sealing (local offset)	Federal Stimulus Funded
56	Residential New Construction M&V Programs (local offset)	Federal Stimulus Funded
57	Residential On-site audit and EE upgrades program (local offset)	Federal Stimulus Funded
58	Residential Solar Electric Generation programs (local offset)	Federal Stimulus Funded
59	Weatherization Assistance (local offset)	Federal Stimulus Funded
60	Water Efficiency Upgrade Project-retrofit of parks (Stimulus funded)	Federal Stimulus Funded
61	Water Efficiency Upgrade Project - retrofit of parks (City Funded)	City Financed
62	Direct Load Control Project (local offset)	Federal Stimulus Funded
63	Business Solar Energy Installation (local offset)	Federal Stimulus Funded
64	Traffic Operational Improvements '04-'05 (Offset)	70% Grant Funded, 30% Traffic Impact Fees
65	Traffic Operational Improvements '06-'07 (Offset)	70% Grant Funded, 30% Traffic Impact Fees
66	Traffic Operational Improvements '08-'09 (Offset)	70% Grant Funded, 30% Traffic Impact Fees
67	Traffic Operational Improvements '10-'12 (Offset)	70% Grant Funded, 30% Traffic Impact Fees
68	Traffic Operational Improvements '13-'15 (Offset)	70% Grant Funded, 30% Traffic Impact Fees
69	PV 8 kW AC RSVL Aquatic CTR (predates analysis)	NA (Completed)
70	PV 18.6 kW AC Fire Station #6	NA (Completed)
71	PV 10 kW AC Middle School	NA (Completed)
72	PV 10 kW AC City Hall	NA (Completed)
73	City Various Buildings - Lighting: 13 Locations	NA (Completed)
74	Various - Vending Misers and Chiller: Oak St. and Main Library	NA (Completed)
75	Dry Creek Motors	NA (Completed)
76	Police Department and Maidu Library	NA (Completed)
77	Corp Yard Task Lighting	NA (Completed)
78	Multiple Building Energy Efficiency Measures	NA (Completed)

8.8 Roseville Street Lighting Base Data

The calculations of street lighting energy and costs savings are based on data provided by Staff and represented in the tables below. The average street lighting energy consumption (kWh) is based on 2008 billing data.

Streetlighting Bundled Energy Cost	
Month	\$13,908.00
Year	\$166,896.00
Avg kWh	2,087,920
Avg kWh cost	\$0.080

Table 27: Effective Average Cost per kWh

Annual Maint cost	
Maintenance Cost	\$62,404

Table 28: Annual Maintenance Cost

Roseville Streetlight Usage			Count
Residential	994,870	66.22%	8710
Intersection/Arterial	507,450	33.78%	2631
Total	1,502,320	100.00%	11341

Table 29: Installed Wattage by Use (nominal)

Street Lights		Count	Total Wattage (nominal)
Residential	70 Watt Decorative	126	8,820
Residential	100 Watt Decorative	80	8,000
Residential	100 Watt High Pressure Sodium	5,951	595,100
Residential	150 Watt High Pressure Sodium	982	147,300
Residential	150 Watt Decorative	1,391	208,650
Int/Arterial	250 Watt High Pressure Sodium	1,323	198,450
Residential	250 Watt Decorative	180	27,000
Int/Arterial	400 Watt High Pressure Sodium	127	50,800
Int/Arterial	175 Watt Mercury Vapor	518	90,650
Int/Arterial	250 Watt Expressway Luminaire	651	162,750
Int/Arterial	400 Watt Expressway Luminaire	12	4,800
Total		11,341	1,502,320

Table 30: Street lighting Inventory and Application

8.9 540 kW CoGen Facility Pleasant Grove Wastewater Treatment Plant Expansion⁷³

Alternative 1B		Average
One 540 kW Engine Generator Cogeneration Facility		
Operation Data		
Average digester gas available (million Btus)	69,011	
Existing boiler fuel consumed (million Btus)	14,192	
New cogen fuel consumed (million Btus)	39,057	
Total fuel consumed (million Btus)	53,249	
Natural gas consumed (million Btus)	10	
Digester gas consumed (million Btus)	53,239	
Cogen heat generated (million Btus)	16,404	
Peak electricity required by plant (kW)	4,806	
Average electricity required by plant (kW)	3,653	
Parasitic electrical usage (kW)	36	
Electricity generated (kW)	540	
Electricity generated by solar - average (kW)	-	
Percentage of full load (%)	100%	
Electricity generated (MW-hrs)	3,976	
Electricity purchased (MW-hrs)	28,024	
Required plant heat - (million Btus)	27,717	
Excess boiler heat req'd (million Btus)		
Daily peak heat demand, million Btu/hr	4.90	
Cogen heating capacity, million Btu/hr	1.87	
Excess (required boiler make up) peak day, million Btu/hr	(3.03)	
Costs/(Revenues) for project		
Natural gas costs	\$ 104	
Base cost for electricity	\$ 4,259,981	
Revenue for displaced electricity	\$ (504,160)	
Revenue for green power credit	\$ (9,289)	
O&M costs for fuel treatment facilities	\$ 3,034	
O&M costs for engine-generator facilities	\$ 99,463	
<i>Total Annual Costs</i>	\$ 3,849,133	
<i>Present Worth of Annual Costs</i>	\$ 2,546,706	
TOTAL PRESENT WORTH	\$ 50,934,112	
Annualized Total Project Capital Cost	\$ 238,260	
Annualized Total Project Benefit	\$ 172,588	
COST TO GENERATE POWER		
<i>Total Annual Cost, \$/kWh</i>	\$0.083	
<i>Projected Electrical Cost, \$/kWh</i>	\$0.127	
TOTAL COST OF OPTION	\$ 54,502,981	
Jenbaucher JMS312A	540	kW per unit
Number of units		
Number of units operating		
Fuel rate, Btu/kW-hr	9,174	full load
Cogeneration heat recovery/fuel input		42%
Power output, kW	540	
Operating hours per year	7,884	
Capital cost estimate, 2006 dollars	\$3,568,869	

⁷³ City of Roseville Pleasant Grove Wastewater Treatment Plant Expansion Technical Memorandum No. 10 Cogeneration Facility Analysis Final, Carollo Engineers, January 2008.

8.10 Fuel Cell CoGen Facility Pleasant Grove Wastewater Treatment Plant⁷⁴

Alternative 3

Two 300 kW Fuel Cell Cogeneration Facility

Operation Data

Average digester gas available (million Btus)	69,011
Existing boiler fuel consumed (million Btus)	25,582
New cogen fuel consumed (million Btus)	36,261
Total fuel consumed (million Btus)	61,842
Natural gas consumed (million Btus)	995
Digester gas consumed (million Btus)	60,847
Cogen heat generated (million Btus)	7,252
Peak electricity required by plant (kW)	4,806
Average electricity required by plant (kW)	3,653
Parasitic electrical usage (kW)	56
Electricity generated (kW)	600
Electricity generated by solar - average (kW)	-
Percentage of full load (%)	100%
Electricity generated (MW-hrs)	4,531
Electricity purchased (MW-hrs)	27,469
Required plant heat - (million Btus)	27,717
Excess boiler heat req'd (million Btus)	
Daily peak heat demand, million Btu/hr	4.90
Cogen heating capacity, million Btu/hr	0.83
Excess (required boiler make up) peak day, million Btu/hr	(4.08)

Costs/(Revenues) for project

Natural gas costs	\$ 10,510
Base cost for electricity	\$ 4,259,981
Revenue for displaced electricity	\$ (574,556)
Revenue for green power credit	\$ (10,586)
O&M costs for fuel treatment facilities	\$ 3,471
O&M costs for fuel cell facilities	\$ 233,308
<i>Total Annual Costs</i>	\$ 3,922,128
<i>Present Worth of Annual Costs</i>	\$ 2,599,176
TOTAL PRESENT WORTH	\$ 51,983,515
Annualized Total Project Capital Cost	\$ 298,039
Annualized Total Project Benefit	\$ 39,814

COST TO GENERATE POWER

<i>Total Annual Cost, \$/kWh</i>	\$0.118
<i>Projected Electrical Cost, \$/kWh</i>	\$0.127

TOTAL COST OF OPTION

Fuel Cell Energy 250 kW	300 kW per unit
Number of units	
Number of units operating	
Fuel rate, Btu/kW-hr	7,262 full load
Cogeneration heat recovery/fuel input	20%
Power output, kW	600
Operating hours per year	8,322
Capital cost estimate, 2006 dollars	\$4,464,300

⁷⁴ City of Roseville Pleasant Grove Wastewater Treatment Plant Expansion Technical Memorandum No. 10 Cogeneration Facility Analysis Final, Carollo Engineers, January 2008.

8.11 Fleet Measure Summary Tables

Vehicle No.	Dept	Year	Measure Summary															
			2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmnt Software Initiatives
00-003	Central Services	2000	y	n	CRN VIC													
00-004	Central Services	2000	y	n	CRN VIC													
00-020	Central Services	2000	y	n	CRN VIC													
00-031	Central Services	2000	y	n	CRN VIC													
00-032	Central Services	2000	y	n	CRN VIC													
00-042	Central Services	2000	y	n	CRN VIC													
00-043	Central Services	2000	y	y	CRN VIC													
00-044	Central Services	2000	y	n	CRN VIC													
00-054	Central Services	2000	y	n	CRN VIC													
00-061	Central Services	2000	y	n	CRN VIC													
00-065	Central Services	2000	y	n	CRN VIC													
00-152	Central Services	2000	y	y	RAM 2500													
00-153	Central Services	2000	y	y	RAM 2500	yes										yes	yes	yes
00-154	Central Services	2000	y	y	TAURUS	yes	yes										yes	yes
00-202	Central Services	2000	y	n	E-350													
00-203	Central Services	2000	y	n	F-150													
00-211	Central Services	2000	y	n	F-150													
00-212	Central Services	2000	y	y	F-150		yes									yes	yes	yes
00-214	Central Services	2000	y	n	F-150													
00-224	Central Services	2000	y	n	F-150													
00-240	Central Services	2000	y	y	F-150		yes									yes	yes	yes
00-242	Central Services	2000	y	n	F-150													
00-259	Central Services	2000	y	n	E-350													
00-267	Central Services	2000	y	y	F-150		yes									yes	yes	yes
00-283	Central Services	2000	y	n	DAKOTA													
00-312	Central Services	2000	y	y	C-3500		yes									yes	yes	yes
00-323	Central Services	2000	y	y	C-3500		yes									yes	yes	yes
00-551	Central Services	2000	y	y	ELEC CARRY													
00-633	Central Services	2000	y	n	455D													
00-634	Central Services	2000	y	n	325D													
00-635	Central Services	2000	y	n	455D													
00-646	Central Services	2000	y	y	LG			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
00-721	Central Services	2000	y	n	GRNDMASTER													
00-722	Central Services	2000	y	n	GRNDMASTER													
00-723	Central Services	2000	y	n	GRASSHOPER													
01-070	Central Services	2001	y	y	DURANGO		yes	yes										yes
01-099	Central Services	2001	y	y	TAURUS		yes	yes										yes
01-157	Central Services	2001	y	y	TAURUS		yes	yes										yes
01-158	Central Services	2001	y	y	TAURUS		yes	yes										yes
01-160	Central Services	2001	y	y	TAURUS		yes	yes										yes
01-220	Central Services	2001	y	n	RAM 2500													
01-250	Central Services	2001	y	y	E-150													
01-256	Central Services	2001	y	y	BR1500													
01-269	Central Services	2001	y	y	Ram 2500		yes									yes	yes	yes
01-276	Central Services	2001	y	y	Ram 2500		yes									yes	yes	yes
01-277	Central Services	2001	y	y	Ram 2500		yes									yes	yes	yes
01-289	Central Services	2001	y	y	Ram 2500		yes									yes	yes	yes
01-290	Central Services	2001	y	n	RAM 2500													
01-291	Central Services	2001	y	n	RAM 2500													
01-293	Central Services	2001	y	y	Ram 3500		yes									yes	yes	yes
01-299	Central Services	2001	y	y	SILVERADO		yes									yes	yes	yes
01-466	Central Services	2001	y	y	GLAVAL 15P			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
01-467	Central Services	2001	y	y	GLAVAL 15P			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
01-468	Central Services	2001	y	n	GLAVAL 15P													
01-469	Central Services	2001	y	y	GLAVAL 15P			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
02-088	Central Services	2002	y	n	CRN VIC													
02-091	Central Services	2002	y	n	CRN VIC													
02-100	Central Services	2002	y	y	WINDSTAR													
02-202	Central Services	2002	y	y	CARGO VAN													
02-204	Central Services	2002	y	y	CARGO VAN													
02-229	Central Services	2002	y	y	Ram 3500		yes									yes	yes	yes
02-297	Central Services	2002	y	y	DURANGO		yes	yes										yes
02-315	Central Services	2002	y	n	DODGE UTL DUMP													
02-316	Central Services	2002	y	y	Utility Truck													
02-810	Central Services	2002	y	n	TRUCKSTER													
02-811	Central Services	2002	y	n	TRUCKSTER													
02-812	Central Services	2002	y	n	Ram 3500													
03-166	Central Services	2003	y	y	TAURUS		yes	yes										yes
03-217	Central Services	2003	y	y	SIERRA-1500													
03-226	Central Services	2003	y	n	SIERRA-1500													
03-286	Central Services	2003	y	y	RANGER		yes											yes
03-504	Central Services	2003	y	n	MOTORCYCLE													
03-619	Central Services	2003	y	y	B-LOADER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-727	Central Services	2003	y	n	5111 MOWER													
03-827	Central Services	2003	y	y	5111 MOWER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
04-502	Central Services	2004	y	n	MOTORCYCLE													
04-503	Central Services	2004	y	n	BMW													
04-514	Central Services	2004	y	n	BMW													
04-515	Central Services	2004	y	n	BMW													
04-531	Central Services	2004	y	n	#R1150RT-P													
04-532	Central Services	2004	y	n	#R1150RT-P													
06-176	Central Services	2006	n	y	TAURUS		yes	yes										yes
06-287	Central Services	2006	n	y	F-250			yes								yes	yes	yes
06-288	Central Services	2006	n	y	F-250			yes								yes	yes	yes
06-300	Central Services	2006	n	y	F-550				yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
87-387	Central Services	1987	y	n	LN8000 DSL													
87-666	Central Services	1987	y	y	H155XL			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

GHG Reduction Action Plan Analysis

Measure Summary																			
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives	
88-307	Central Services	1988	y	y	CRANE			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
88-398	Central Services	1988	y	n	STEP														
88-683	Central Services	1988	y	y	GCS/17S														
89-328	Central Services	1989	y	y	DUMP C8000			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
89-417	Central Services	1989	y	n	PUMPER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
89-418	Central Services	1989	y	y	F-350			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
89-686	Central Services	1989	y	n	FER W/SMR														
89-697	Central Services	1989	y	n	310C														
90-035	Central Services	1990	y	y	4 RUNNER														
90-087	Central Services	1990	y	n	E-150														
90-331	Central Services	1990	y	y	FLATBED			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
90-420	Central Services	1991	y	n	FIRE TRK														
91-228	Central Services	1990	y	y	SAFARI														
91-347	Central Services	1991	y	n	F-700														
91-359	Central Services	1991	y	n	BEN ROLL														
91-657	Central Services	1991	y	y	GPX-25														
92-255	Central Services	1991	y	n	JIMMY														
92-258	Central Services	1991	y	n	JIMMY														
92-366	Central Services	1992	y	n	4900														
94-279	Central Services	1994	y	n	CARGO VAN														
94-280	Central Services	1994	y	n	SONOMA														
94-281	Central Services	1994	y	n	SAFARI														
94-381	Central Services	1994	y	n	ROLL-ON														
94-385	Central Services	1994	y	n	SIERRA-3500														
94-388	Central Services	1994	y	y	0			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
94-389	Central Services	1994	y	n	C-3500														
94-815	Central Services	1994	n	y	805X9E			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
94-818	Central Services	1994	y	n	DD22														
95-059	Central Services	1994	y	n	LUMINA														
95-061	Central Services	1994	y	y	LUMINA	yes	yes											yes	
95-062	Central Services	1994	y	n	LUMINA														
95-282	Central Services	1994	y	n	S-10 PU														
95-287	Central Services	1995	y	n	C-2500														
95-291	Central Services	1995	y	y	PU G412														
95-292	Central Services	1995	y	y	SIERRA-1500														
95-344	Central Services	1995	y	n	C-3500														
95-345	Central Services	1995	y	n	C-3500														
95-402	Central Services	1994	y	n	VERSALIFT														
95-403	Central Services	1994	y	y	DUMP TRUCK			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
95-408	Central Services	1995	y	n	16X7 DUMP														
95-424	Central Services	1994	y	n	K20906														
95-425	Central Services	1995	y	n	Refuse Truck														
95-426	Central Services	1995	y	n	SIDELOADER														
96-065	Central Services	1996	y	y	AEROSTAR														
96-066	Central Services	1996	y	n	AEROSTAR														
96-067	Central Services	1996	y	y	AEROSTAR														
96-084	Central Services	1996	y	n	CRN VIC														
96-101	Central Services	1996	y	y	CONTOUR														
96-150	Central Services	1996	y	n	CIERA														
96-151	Central Services	1996	y	n	CIERA														
96-293	Central Services	1996	y	n	RAM 1500														
96-294	Central Services	1996	y	n	RANGER														
96-317	Central Services	1996	y	n	FLATBED														
96-333	Central Services	1996	y	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
96-353	Central Services	1996	y	y	DIGGER ALT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
96-427	Central Services	1996	y	n	SD/LDR														
96-428	Central Services	1996	y	n	SD/LDR														
96-429	Central Services	1996	y	n	FRONT/LOADER														
96-430	Central Services	1996	y	n	FRONTLDR														
96-431	Central Services	1996	y	n	MR688S														
96-680	Central Services	1996	y	n	BACKHOE/LO			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
96-681	Central Services	1996	y	y	BACKHOE/LD			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
96-700	Central Services	1996	y	n	GATOR 6X4														
96-828	Central Services	1996	y	y	JNSTON 605			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
97-008	Central Services	1997	y	n	CRN VIC														
97-010	Central Services	1997	y	n	CRN VIC														
97-110	Central Services	1997	y	n	TAURUS														
97-111	Central Services	1997	y	n	TAURUS														
97-204	Central Services	1997	y	n	F-250														
97-205	Central Services	1997	y	y	F-250		yes					yes		yes		yes		yes	
97-210	Central Services	1997	y	n	SONOMA														
97-214	Central Services	1997	y	n	CARGO VAN														
97-224	Central Services	1997	y	n	F-250														
97-229	Central Services	1997	y	y	RANGER		yes											yes	
97-235	Central Services	1997	y	n	RANGER														
97-237	Central Services	1998	y	y	WINDSTAR														
97-242	Central Services	1997	y	n	F-150														
97-251	Central Services	1997	y	y	F-250		yes					yes		yes		yes		yes	
97-258	Central Services	1997	y	n	F-250														
97-275	Central Services	1997	y	n	F-250														
97-309	Central Services	1997	y	n	VERSALIFT														
97-318	Central Services	1997	y	n	RODDER VAC														
97-319	Central Services	1997	y	n	Refuse Truck														
97-326	Central Services	1997	y	y	DUMP TRUCK		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
97-379	Central Services	1997	y	n	VERSALIFT														
98-002	Central Services	1998	y	n	CRN VIC														
98-0060	Central Services	1998	y	n	CRN VIC														
98-014	Central Services	1998	y	n	CRN VIC														
98-016	Central Services	1998	y	n	CRN VIC														

GHG Reduction Action Plan Analysis

Measure Summary																			
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmnt Software Initiatives	
98-018	Central Services	1998	y	n	CRN VIC														
98-020	Central Services	1998	y	y	CRN VIC	yes													
98-108	Central Services	1998	y	y	TAURUS	yes	yes												yes
98-109	Central Services	1998	y	n	TAURUS														
98-112	Central Services	1998	y	y	TAURUS	yes	yes												yes
98-206	Central Services	1998	y	n	SIERRA-1500														
98-212	Central Services	1998	y	n	SIERRA-1500														
98-217	Central Services	1998	y	n	SAFARI														
98-218	Central Services	1998	y	n	SONOMA														
98-219	Central Services	1998	y	n	SONOMA														
98-220	Central Services	1998	y	n	SONOMA														
98-221	Central Services	1998	y	n	SONOMA														yes
98-222	Central Services	1998	y	y	SONOMA		yes												
98-239	Central Services	1998	y	y	CARGO VAN														
98-243	Central Services	1998	y	n	RANGER														
98-252	Central Services	1998	y	y	SIERRA-3500		yes												yes
98-305	Central Services	1998	y	n	15 PASS														
98-323	Central Services	1998	y	n	C-3500														
98-364	Central Services	1998	y	n	C-3500														
98-370	Central Services	1998	y	y	SIERRA-3500		yes												yes
98-390	Central Services	1998	y	y	SIERRA-3500		yes												yes
98-394	Central Services	1998	y	n	C-3500														
98-397	Central Services	1998	y	y	DUMP TRUCK			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
98-602	Central Services	1998	y	y	BACKHOE			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
98-630	Central Services	1998	y	n	BACKHOE														
99-024	Central Services	1999	y	n	CRN VIC														
99-025	Central Services	1999	y	y	CRN VIC		yes												
99-027	Central Services	1999	y	y	CRN VIC		yes												
99-030	Central Services	1999	y	n	CRN VIC														
99-031	Central Services	1999	y	n	BT-57														
99-207	Central Services	1999	y	y	SONOMA		yes												yes
99-208	Central Services	1999	y	n	SONOMA														
99-215	Central Services	1999	y	y	SONOMA		yes												yes
99-225	Central Services	1999	y	n	SONOMA														
99-228	Central Services	1999	y	y	SONOMA		yes												yes
99-234	Central Services	1999	y	n	RAM 1500														
99-249	Central Services	1999	y	n	SONOMA														
99-250	Central Services	1999	y	y	SONOMA		yes												yes
99-254	Central Services	1999	y	n	SONOMA														
99-255	Central Services	1999	y	y	SONOMA		yes												yes
99-256	Central Services	1999	y	n	CARGO VAN														
99-272	Central Services	1999	y	n	RAM 2500														
99-279	Central Services	1999	y	n	RAM 2500														
99-281	Central Services	1999	y	n	SONOMA														
99-300	Central Services	1999	y	y	VACTOR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-301	Central Services	1999	y	y	STEP VAN														
99-360	Central Services	1999	y	y	VERSALIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-372	Central Services	1999	y	y	C-3500		yes												yes
99-374	Central Services	1999	y	y	FLAT BED														
99-375	Central Services	1999	y	y	FLAT BED														
99-393	Central Services	1999	y	n	CONST TRK														
99-706	Central Services	1999	y	n	PRESR WSHR														
99-707	Central Services	1999	y	n	PLANER														
99-715	Central Services	1999	y	n	ASPH PAVER														
99-720	Central Services	1999	y	n	GATOR 6X4														
07-281	City Manager	2007	n	y	E-150														
97-124	Community Services	1997	y	y	TAURUS		yes	yes											yes
00-302	Electric	2000	y	y	4900			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-335	Electric	2000	y	y	C-3500			yes											yes
00-480	Electric	2000	y	y	4700			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-159	Electric	2001	y	y	DAKOTA			yes											
01-170	Electric	2001	y	y	DAKOTA			yes											
01-171	Electric	2001	y	y	RAM 2500			yes											yes
01-206	Electric	2001	y	y	RAM 2500			yes											yes
01-215	Electric	2001	y	y	SAFARI			yes											yes
01-340	Electric	2001	y	y	BOX TRUCK														
01-341	Electric	2001	y	y	BOX TRUCK														
01-342	Electric	2001	y	y	Ram 3500			yes											
01-347	Electric	2001	y	y	ALTC AT37G			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-362	Electric	2001	y	y	Ram 3500			yes											yes
01-372	Electric	2001	y	y	F-350			yes											yes
01-381	Electric	2001	y	y	FL80-ALTEC			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-386	Electric	2001	y	y	RAM 3500			yes											yes
02-200	Electric	2002	y	y	DAKOTA			yes											yes
02-231	Electric	2002	n	y	DAKOTA			yes											yes
02-260	Electric	2002	y	y	SILVERADO			yes											yes
02-263	Electric	2002	y	y	C-2500			yes											yes
02-282	Electric	2002	y	y	SIERRA-1500														
02-354	Electric	2002	y	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-392	Electric	2002	y	y	ALTEC LIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-164	Electric	2003	y	y	Ram 2500			yes											
03-227	Electric	2003	y	y	DAKOTA			yes											
03-236	Electric	2003	y	y	RANGER			yes											
03-295	Electric	2003	y	y	DAKOTA			yes											
03-307	Electric	2003	y	y	TMS500E			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-317	Electric	2003	y	y	DUCT DAWG			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-326	Electric	2003	y	y	FL80-ALTEC			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-350	Electric	2003	y	y	VERSALIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-351	Electric	2003	y	y	VRSALIFTBKT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-380	Electric	2003	y	y	VERSALIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
04-235	Electric	2004	y	y	F-250		yes						yes	yes	yes	yes	yes	yes
04-247	Electric	2004	y	y	F-350		yes					yes						
04-277	Electric	2004	y	y	C-3500		yes					yes						
04-283	Electric	2004	y	y	EXT PICKUP													
04-402	Electric	2004	y	y	ALTEC LIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
04-608	Electric	2004	y	y	FORKLIFT													
04-750	Electric	2004	y	y	FX60-800			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-232	Electric	2005	y	y	SILVERADO		yes					yes						
05-309	Electric	2005	y	y	C7500			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-366	Electric	2005	n	y	DIGGER ALT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-384	Electric	2005	y	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-H01	Electric	2005	y	y	CIVIC	yes	yes											yes
05-H02	Electric	2005	y	y	CIVIC	yes	yes											yes
06-243	Electric	2006	y	y	SILVERADO		yes					yes						
06-331	Electric	2006	n	y	FLATBED			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-393	Electric	2006	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-555	Electric	2006	n	y	ALTEC LIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-644	Electric	2006	n	y	POLE DLY			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-H03	Electric	2006	y	y	PRIUS													
06-H04	Electric	2006	y	y	PRIUS													
07-195	Electric	2007	n	y	E-150													
07-353	Electric	2007	n	y	7600 SBA 6X4			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-360	Electric	2007	n	y	VERSALIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-373	Electric	2007	n	y	VERSALIFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-379	Electric	2007	n	y	AERIAL LFT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-396	Electric	2007	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-662	Electric	2007	n	y	P185WJD			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-663	Electric	2007	n	y	P185WJD			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-370	Electric	2008	n	y	F-350		yes											yes
08-378	Electric	2008	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-390	Electric	2008	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-681	Electric	2008	n	y	430E													
90-321	Electric	1990	y	n	C8000													
96-352	Electric	1996	y	y	6H-75PB1			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
96-354	Electric	1996	y	y	F-350		yes											yes
98-378	Electric	1998	y	y	SIERRA-3500		yes											yes
98-650	Electric	1998	y	y	REEL TRAIL													yes
99-246	Electric	1999	y	y	SONOMA		yes											
99-280	Electric	1999	y	y	SONOMA		yes											
99-296	Electric	1999	y	y	RAM 2500		yes					yes						
99-297	Electric	1999	y	y	RAM 2500		yes					yes						
99-337	Electric	1999	y	y	SIERRA-3500		yes					yes						
99-646	Electric	1999	y	y	HOGG DAVIS			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-210	Environmental Utility	2000	y	y	F-150		yes											
00-324	Environmental Utility	2000	y	y	LT-7501			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-338	Environmental Utility	2000	y	y	LT7501			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-450	Environmental Utility	2000	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-451	Environmental Utility	2000	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-622	Environmental Utility	2000	y	y	CAT 426C			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-209	Environmental Utility	2001	y	y	S-10 PU			yes										
01-209	Environmental Utility	2001	y	y	Ram 1500			yes				yes						
01-219	Environmental Utility	2001	y	y	RAM 2500			yes				yes						
01-233	Environmental Utility	2001	y	y	DAKOTA			yes										
01-243	Environmental Utility	2001	y	y	F-350			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-265	Environmental Utility	2001	y	y	RAM 1500			yes				yes						
01-334	Environmental Utility	2001	y	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-346	Environmental Utility	2001	y	n	BOX TV VAN													
01-368	Environmental Utility	2001	y	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-371	Environmental Utility	2001	y	y	F-350		yes					yes						
01-373	Environmental Utility	2001	y	y	F-350		yes					yes						
01-454	Environmental Utility	2001	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-455	Environmental Utility	2001	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-456	Environmental Utility	2001	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-457	Environmental Utility	2001	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-608	Environmental Utility	2001	y	y	SKID STEER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-616	Environmental Utility	2001	y	y	4500 TRCTR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-218	Environmental Utility	2002	y	y	SILVERADO			yes										
02-246	Environmental Utility	2002	y	y	DAKOTA			yes										
02-288	Environmental Utility	2002	y	y	DAKOTA													
02-292	Environmental Utility	2002	y	y	DAKOTA													
02-310	Environmental Utility	2002	y	y	Ram 3500			yes				yes						
02-314	Environmental Utility	2003	y	y	FL80 DMPTK			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-320	Environmental Utility	2002	y	y	CREW CAB													
02-322	Environmental Utility	2002	y	y	F-350			yes										
02-349	Environmental Utility	2002	y	y	EX CAB4WD			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-356	Environmental Utility	2002	y	y	E-350													
02-367	Environmental Utility	2003	y	y	FL80 DMPTK			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-375	Environmental Utility	2002	y	y	FRT LDR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-383	Environmental Utility	2002	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-385	Environmental Utility	2002	y	y	Ram 3500			yes										
02-458	Environmental Utility	2002	y	y	Refuse Truck			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-623	Environmental Utility	2002	n	y	COMPRESSOR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-802	Environmental Utility	2002	y	y	ELECT CART													
02-840	Environmental Utility	2002	y	n	CMT-100													
03-160	Environmental Utility	2003	y	y	DAKOTA													yes
03-161	Environmental Utility	2003	y	y	DAKOTA													yes
03-162	Environmental Utility	2003	y	y	F-250			yes										yes
03-222	Environmental Utility	2003	y	y	C-2500			yes										yes
03-244	Environmental Utility	2003	y	y	DAKOTA			yes										yes

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replace ment A	Fleet Replace ment B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmnt Software Initiatives
03-270	Environmental Utilities	2003	y	y	CARGO VAN													
03-285	Environmental Utilities	2003	y	y	DAKOTA	yes											yes	
03-304	Environmental Utilities	2003	y	y	FORK TRUCK													
03-344	Environmental Utilities	2003	y	y	F-350	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-357	Environmental Utilities	2003	y	y	CRANE/UTIL		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-490	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-491	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-492	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-493	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-494	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-495	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-496	Environmental Utilities	2003	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
03-660	Environmental Utilities	2003	y	y	FORKLIFT													
03-681	Environmental Utilities	2003	y	y	430D		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-730	Environmental Utilities	2003	y	y	VACTOR		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
04-212	Environmental Utilities	2004	y	y	E-450													
04-213	Environmental Utilities	2004	y	y	F-450	yes							yes	yes		yes	yes	yes
04-214	Environmental Utilities	2004	y	y	C-2500	yes							yes	yes	yes	yes	yes	yes
04-237	Environmental Utilities	2004	y	y	F-250	yes							yes	yes	yes	yes	yes	yes
04-324	Environmental Utilities	2004	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
04-325	Environmental Utilities	2004	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
04-381	Environmental Utilities	2004	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
04-382	Environmental Utilities	2004	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
04-391	Environmental Utilities	2004	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-110	Environmental Utilities	2005	y	y	STRATUS	yes	yes											yes
05-215	Environmental Utilities	2005	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-224	Environmental Utilities	2005	y	y	SILVERADO		yes						yes	yes	yes	yes	yes	yes
05-225	Environmental Utilities	2005	y	y	SILVERADO		yes						yes	yes	yes	yes	yes	yes
05-226	Environmental Utilities	2005	y	y	SILVERADO		yes						yes	yes	yes	yes	yes	yes
05-228	Environmental Utilities	2005	y	y	DAKOTA		yes											yes
05-252	Environmental Utilities	2005	y	y	S-10 PU		yes											yes
05-253	Environmental Utilities	2005	y	y	SILVERADO		yes							yes	yes	yes	yes	yes
05-290	Environmental Utilities	2005	y	y	C-3500		yes							yes	yes	yes	yes	yes
05-459	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-480	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-481	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-482	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-483	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-484	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-485	Environmental Utilities	2005	y	y	Refuse Truck	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
05-813	Environmental Utilities	2005	y	y	RANGER 2X4													
06-233	Environmental Utilities	2006	y	y	SILVERADO		yes							yes	yes	yes	yes	yes
06-234	Environmental Utilities	2006	y	y	SILVERADO		yes							yes	yes	yes	yes	yes
06-318	Environmental Utilities	2006	n	y	VACTOR		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-319	Environmental Utilities	2006	y	y	LT-7501		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-358	Environmental Utilities	2006	y	y	DURANGO	yes	yes											yes
06-391	Environmental Utilities	2006	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-394	Environmental Utilities	2006	n	y	C-3500		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-395	Environmental Utilities	2006	n	y	C-3500		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-397	Environmental Utilities	2006	n	y	C-2500		yes							yes	yes	yes	yes	yes
06-398	Environmental Utilities	2006	n	y	M2106		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-470	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-471	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-472	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-475	Environmental Utilities	2006	n	y	VACTOR		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-486	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-487	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-488	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-489	Environmental Utilities	2006	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-654	Environmental Utilities	2006	n	y	PUMP		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-659	Environmental Utilities	2006	n	y	430E		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
06-760	Environmental Utilities	2006	n	y	GATOR 6X4													
06-842	Environmental Utilities	2006	n	y	AZ-360HD			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-111	Environmental Utilities	2007	n	y	SEBRING													
07-199	Environmental Utilities	2007	n	y	COLORADO		yes											yes
07-208	Environmental Utilities	2007	n	y	COLORADO		yes											yes
07-220	Environmental Utilities	2007	n	y	COLORADO		yes											yes
07-234	Environmental Utilities	2007	n	y	COLORADO		yes											yes
07-271	Environmental Utilities	2007	n	y	COLORADO		yes											yes
07-272	Environmental Utilities	2007	y	y	COLORADO		yes											yes
07-273	Environmental Utilities	2007	y	y	COLORADO		yes											yes
07-313	Environmental Utilities	2007	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-369	Environmental Utilities	2007	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
07-391	Environmental Utilities	2007	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
07-405	Environmental Utilities	2007	n	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
07-626	Environmental Utilities	2007	n	y	P3500-LP													
07-656	Environmental Utilities	2007	n	y	430E			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-657	Environmental Utilities	2007	n	y	P3500-LP													
07-720	Environmental Utilities	2007	n	y	GATOR													
07-818	Environmental Utilities	2007	n	y	B2-48-48													
07-850	Environmental Utilities	2007	n	y	48U													
08-202	Environmental Utilities	2008	n	y	COLORADO		yes											yes
08-203	Environmental Utilities	2008	n	y	F-250		yes							yes	yes	yes	yes	yes
08-204	Environmental Utilities	2008	n	y	SILVERADO		yes							yes	yes	yes	yes	yes
08-211	Environmental Utilities	2008	n	y	F-250		yes							yes	yes	yes	yes	yes
08-215	Environmental Utilities	2008	n	y	COLORADO		yes											yes
08-239	Environmental Utilities	2008	n	y	CARGO VAN													
08-240	Environmental Utilities	2008	n	y	SILVERADO		yes						yes	yes	yes	yes	yes	yes
08-249	Environmental Utilities	2008	n	y	COLORADO		yes											yes

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replace ment A	Fleet Replace ment B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
08-259	Environmental Utilities	2008	n	y	COLORADO		yes											yes
08-267	Environmental Utilities	2008	n	y	SILVERADO		yes						yes		yes		yes	yes
08-280	Environmental Utilities	2008	n	y	ESCAPE	yes	yes											yes
08-311	Environmental Utilities	2008	n	y	FLTBED/DMP			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
08-332	Environmental Utilities	2008	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-339	Environmental Utilities	2008	n	y	C-3500		yes						yes		yes		yes	
08-359	Environmental Utilities	2008	n	y	Refuse Truck		yes							yes		yes		yes
08-393	Environmental Utilities	2008	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-636	Environmental Utilities	2008	n	y	304CCR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-851	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-852	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-853	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-854	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-855	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-856	Environmental Utilities	2008	n	y	TIGER TRUCK													
08-857	Environmental Utilities	2008	n	y	TIGER TRUCK													
88-302	Environmental Utilities	1988	y	y	CRANE TRK			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
97-313	Environmental Utilities	1997	y	y	FLTBED/DMP													
97-614	Environmental Utilities	1997	y	y	Q125DJE				yes	yes	yes	yes	yes	yes	yes	yes	yes	
98-363	Environmental Utilities	1998	y	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
98-656	Environmental Utilities	1998	y	y	BACKHOE			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-209	Environmental Utilities	1999	y	y	SONOMA		yes											
99-271	Environmental Utilities	1999	y	y	F-150		yes								yes	yes	yes	
99-273	Environmental Utilities	1999	y	y	CHEROKEE													
99-314	Environmental Utilities	1999	y	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-324	Environmental Utilities	1999	y	y	F-350		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
99-355	Environmental Utilities	1999	y	y	F-350		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
99-391	Environmental Utilities	1999	y	y	4700			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-399	Environmental Utilities	1999	y	y	L8501			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-433	Environmental Utilities	1999	y	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-452	Environmental Utilities	1999	y	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-453	Environmental Utilities	1999	y	y	Refuse Truck		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-262	Finance	2000	y	y	DAKOTA		yes											yes
01-225	Finance	2001	y	y	DAKOTA		yes											yes
01-226	Finance	2001	y	y	DAKOTA		yes											yes
01-227	Finance	2001	y	y	DAKOTA		yes											yes
01-266	Finance	2001	y	y	S-10 PU		yes											yes
02-294	Finance	2002	y	y	DAKOTA		yes											yes
02-295	Finance	2002	y	y	DAKOTA		yes											yes
03-211	Finance	2003	y	y	C-2500		yes								yes	yes	yes	yes
04-245	Finance	2004	y	y	DAKOTA		yes											yes
08-255	Finance	2008	n	y	COLORADO		yes											yes
08-283	Finance	2008	n	y	COLORADO		yes											yes
00-427	Fire	2000	y	y	LTI-TILLER													
00-428	Fire	2000	y	y	GLADIATOR													
00-429	Fire	2000	y	y	GLADIATOR													
00-430	Fire	2000	y	y	GLADIATOR													
01-213	Fire	2001	y	y	Ram 1500		yes											yes
01-286	Fire	2001	y	y	RAM 1500		yes											yes
02-298	Fire	2002	y	y	DAKOTA		yes											yes
02-411	Fire	2002	y	y	CK2506													
02-418	Fire	2002	y	y	4565 420													
03-234	Fire	2003	y	y	DAKOTA		yes											yes
03-312	Fire	2003	y	y	CREW CAB													
03-313	Fire	2003	y	y	EXPEDITION		yes	yes										yes
03-314	Fire	2003	y	y	EXPEDITION		yes	yes										yes
03-432	Fire	2003	y	y	FIRE ENGIN													
03-433	Fire	2003	y	y	FIRE ENGIN													
03-434	Fire	2003	y	y	FIRE ENGIN													
04-422	Fire	2004	y	y	SPARTAN GLAD													
04-435	Fire	2004	y	y	MINI PUMP													
04-436	Fire	2004	y	y	MINI PUMP													
04-437	Fire	2004	y	y	MINI PUMP													
05-235	Fire	2005	y	y	RANGER		yes											yes
05-419	Fire	2005	y	y	F-550													
06-200	Fire	2006	n	y	SILVERADO		yes											yes
06-201	Fire	2006	n	y	CARAVAN													
06-211	Fire	2006	n	y	C-1500		yes											yes
06-302	Fire	2006	n	y	EXPEDITION		yes	yes										yes
06-303	Fire	2006	n	y	EXPEDITION		yes	yes										yes
06-438	Fire	2006	n	y	FIRE ENGIN													
06-439	Fire	2006	n	y	FIRE ENGIN													
06-440	Fire	2006	n	y	FIRE ENGIN													
06-441	Fire	2006	n	y	FIRE ENGIN													
06-442	Fire	2006	n	y	HAZ													
06-443	Fire	2006	n	y	C-3500		yes											yes
06-734	Fire	2006	n	y	GTI													
06-735	Fire	2006	n	y	GTI													
07-105	Fire	2007	n	y	IMPALA													
07-424	Fire	2007	n	y	TAHOE		yes	yes										yes
07-425	Fire	2007	n	y	TAHOE		yes	yes										yes
07-438	Fire	2007	n	y	E134042S													
07-439	Fire	2007	n	y	E134042S													
86-413	Fire	1986	y	y	HENDRIKSON													
89-416	Fire	1989	y	y	PIERCE PUM													
97-425	Fire	1997	y	y	GLADIATOR													
99-230	Fire	1999	y	y	SONOMA		yes											yes
99-231	Fire	1999	y	y	SONOMA		yes											yes
99-233	Fire	1999	y	y	SONOMA		yes											yes
99-238	Fire	1999	y	y	VAN 8 PASS													

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Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replace ment A	Fleet Replace ment B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
99-253	Fire	1999	y	y	TAHOE	yes	yes											yes
99-426	Fire	1999	y	y	F-550													
01-237	Human Resources	2001	y	y	WINDSTAR													
00-001	IT	2000	y	y	CRN VIC	yes												
03-101	IT	2003	y	y	WINDSTAR													
03-102	IT	2003	y	y	SAFARI													
96-097	IT	1996	y	y	CRN VIC	yes												
97-236	IT	1997	y	y	AEROSTAR													
98-216	IT	1998	y	y	SAFARI													
01-287	Libraries	2001	y	y	CARGO VAN													
00-206	Parks & Rec	2000	y	y	F-150	yes						yes						
00-221	Parks & Rec	2000	y	y	SIERRA-3500	yes					yes	yes	yes	yes	yes	yes	yes	yes
00-264	Parks & Rec	2000	y	y	DAKOTA	yes												yes
00-265	Parks & Rec	2000	y	y	C-3500	yes					yes	yes	yes	yes	yes	yes	yes	yes
00-361	Parks & Rec	2000	y	y	SIERRA-3500	yes					yes	yes	yes	yes	yes	yes	yes	yes
00-580	Parks & Rec	2000	y	y	TRCTR 4400			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-631	Parks & Rec	2000	y	y	4600			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
00-753	Parks & Rec	2000	y	y	AERWAY FIE													
00-800	Parks & Rec	2000	y	y	TRENCHER													
01-201	Parks & Rec	2001	y	y	RAM 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-208	Parks & Rec	2001	y	y	Ram 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-212	Parks & Rec	2001	y	y	DAKOTA	yes												yes
01-216	Parks & Rec	2001	y	y	SAFARI													
01-239	Parks & Rec	2001	y	y	SAFARI													
01-241	Parks & Rec	2001	y	y	CARGO VAN													
01-267	Parks & Rec	2001	y	y	Ram 3500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-271	Parks & Rec	2001	y	y	F-350	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-274	Parks & Rec	2001	y	y	Ram 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-275	Parks & Rec	2001	y	y	Ram 3500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-278	Parks & Rec	2001	y	y	RAM 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-282	Parks & Rec	2001	y	y	RAM 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-284	Parks & Rec	2001	y	y	Ram 2500	yes					yes	yes	yes	yes	yes	yes	yes	yes
01-315	Parks & Rec	2001	y	y	CHIPPER													
01-360	Parks & Rec	2001	y	y	DMP CHIPPR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-697	Parks & Rec	2001	y	y	426C			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
01-770	Parks & Rec	2001	y	y	BRUSH BNDT			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-276	Parks & Rec	2002	y	y	DAKOTA	yes												yes
02-327	Parks & Rec	2002	y	y	PU DUMPBED													
02-341	Parks & Rec	2002	y	y	F-350	yes							yes	yes	yes	yes	yes	
02-342	Parks & Rec	2002	y	y	F-350	yes						yes	yes	yes	yes	yes	yes	
02-343	Parks & Rec	2002	y	y	F-350	yes						yes	yes	yes	yes	yes	yes	
02-603	Parks & Rec	2002	y	y	721D MOWER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-668	Parks & Rec	2002	y	y	EQ 4500			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-707	Parks & Rec	2002	y	y	PRESS WASH			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
02-783	Parks & Rec	2002	y	y	898657													
02-801	Parks & Rec	2002	y	y	898657													
02-E03	Parks & Rec	2002	y	y	THINK CAR													
02-E04	Parks & Rec	2002	y	y	THINK CAR													
03-163	Parks & Rec	2003	y	y	DAKOTA	yes												yes
03-345	Parks & Rec	2003	y	y	EXT LIFTBD													
03-348	Parks & Rec	2003	y	y	EXT CAB													
03-364	Parks & Rec	2003	y	y	C-3500	yes							yes	yes	yes	yes	yes	
03-365	Parks & Rec	2003	y	y	C-3500	yes						yes	yes	yes	yes	yes	yes	
03-366	Parks & Rec	2003	y	y	LIFT BED													
03-367	Parks & Rec	2003	y	y	X-CAB													
03-368	Parks & Rec	2003	y	y	EXT LIFTBD													
03-387	Parks & Rec	2003	y	y	EXT PICKUP													
03-661	Parks & Rec	2003	y	y	TRCTR5520N			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
04-715	Parks & Rec	2004	y	y	SPRAYER			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-209	Parks & Rec	2005	y	y	C-2500	yes							yes	yes	yes	yes	yes	
05-210	Parks & Rec	2005	y	y	RANGER	yes												
05-291	Parks & Rec	2005	y	y	SILVERADO	yes							yes	yes	yes	yes	yes	
05-292	Parks & Rec	2005	y	y	SILVERADO	yes							yes	yes	yes	yes	yes	
05-293	Parks & Rec	2005	y	y	C-2500	yes							yes	yes	yes	yes	yes	
05-294	Parks & Rec	2005	y	y	F-350	yes							yes	yes	yes	yes	yes	
05-295	Parks & Rec	2005	y	y	F-350	yes							yes	yes	yes	yes	yes	
05-717	Parks & Rec	2005	y	y	Z597D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-718	Parks & Rec	2005	y	y	Z597D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-719	Parks & Rec	2005	y	y	4000D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-263	Parks & Rec	2006	n	y	F-250	yes								yes	yes	yes	yes	
06-266	Parks & Rec	2006	n	y	Utility Truck									yes	yes	yes	yes	
06-269	Parks & Rec	2006	n	y	SILVERADO	yes								yes	yes	yes	yes	
06-633	Parks & Rec	2006	n	y	4100-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-634	Parks & Rec	2006	n	y	3280-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-673	Parks & Rec	2006	y	y	GATOR													
06-702	Parks & Rec	2006	n	y	GATOR													
06-703	Parks & Rec	2006	n	y	GATOR													
06-721	Parks & Rec	2006	n	y	3280-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-722	Parks & Rec	2006	n	y	3280-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-801	Parks & Rec	2006	n	y	1590			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-802	Parks & Rec	2006	n	y	UTIL. CART													
06-805	Parks & Rec	2006	n	y	UTIL. CART													
06-807	Parks & Rec	2006	n	y	UTIL. CART													
06-808	Parks & Rec	2006	n	n	UTIL. CART													
07-207	Parks & Rec	2007	n	y	COLORADO	yes												yes
07-238	Parks & Rec	2007	n	y	COLORADO	yes												yes
07-250	Parks & Rec	2007	n	y	COLORADO	yes												yes
07-254	Parks & Rec	2007	n	y	COLORADO	yes												yes
07-259	Parks & Rec	2007	n	y	COLORADO	yes												yes
07-627	Parks & Rec	2007	n	y	D1105-ES02			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
07-635	Parks & Rec	2007	n	y	3500-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-667	Parks & Rec	2007	n	y	TC55DA			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-693	Parks & Rec	2007	n	y	TC55DA			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-723	Parks & Rec	2007	n	y	7200			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-727	Parks & Rec	2007	n	y	4100-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
07-751	Parks & Rec	2007	n	y	AERATOR 800													
08-275	Parks & Rec	2008	n	y	F-250	yes						yes		yes	yes	yes	yes	yes
08-277	Parks & Rec	2008	n	y	TRAILBLAZER	yes	yes									yes	yes	
08-328	Parks & Rec	2008	n	y	4400 SBA			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-386	Parks & Rec	2008	n	y	F-550			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-406	Parks & Rec	2008	n	y	7400 SBA 4X2			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-606	Parks & Rec	2008	n	y	74417													
08-824	Parks & Rec	2008	n	y	5700													
08-826	Parks & Rec	2008	n	y	7264													
08-827	Parks & Rec	2008	n	y	3500-D			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
95-347	Parks & Rec	1995	y	n	C-3500													
98-653	Parks & Rec	1998	y	y	TRACTR4100			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
98-701	Parks & Rec	1998	y	y	RAYCO 1672			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
98-104	Planning	1998	y	y	TAURUS	yes	yes											yes
00-062	Police	2000	y	y	CRN VIC	yes												
00-064	Police	2000	y	y	CRN VIC	yes												
00-066	Police	2000	y	y	CRN VIC	yes												
00-155	Police	2000	y	y	TAURUS	yes	yes											yes
00-156	Police	2000	y	y	SAVANA													
00-511	Police	2000	y	y	CV836T 36'													
01-033	Police	2001	y	y	TAURUS	yes	yes											yes
01-038	Police	2001	y	y	TAURUS	yes	yes											yes
01-046	Police	2001	y	y	TAURUS	yes	yes											yes
01-152	Police	2001	y	y	ASTRO VAN													
02-005	Police	2002	y	y	CRN VIC	yes												
02-011	Police	2002	y	y	CRN VIC	yes												
02-012	Police	2002	y	y	CRN VIC	yes												
02-019	Police	2002	y	y	CRN VIC	yes												
02-034	Police	2002	y	y	CRN VIC	yes												
02-036	Police	2002	y	y	CRN VIC	yes												
02-037	Police	2002	y	y	CRN VIC	yes												
02-047	Police	2002	y	y	SEDAN 4 DR													
02-056	Police	2002	y	y	STRATUS	yes	yes											yes
02-057	Police	2002	y	y	STRATUS	yes	yes											yes
02-059	Police	2002	y	y	STRATUS	yes	yes											yes
02-071	Police	2002	y	y	CRN VIC	yes												
02-081	Police	2002	y	y	CRN VIC	yes												
02-082	Police	2002	y	y	CRN VIC	yes												
02-084	Police	2002	y	y	CRN VIC	yes												
02-085	Police	2002	y	y	CRN VIC	yes												
02-086	Police	2002	y	y	CRN VIC	yes												
02-092	Police	2002	y	y	CRN VIC	yes												
02-093	Police	2002	y	y	CRN VIC	yes												
02-095	Police	2002	y	y	CRN VIC	yes												
02-096	Police	2002	y	y	CRN VIC	yes												
02-097	Police	2002	y	y	CRN VIC	yes												yes
02-134	Police	2002	n	y	ACCORD	yes	yes											yes
02-258	Police	2002	y	y	SILVERADO	yes												yes
02-505	Police	2002	y	y	MOTORCYCLE													
03-013	Police	2003	y	y	CRN VIC	yes												
03-035	Police	2003	y	y	CRN VIC	yes												
03-040	Police	2003	y	y	CRN VIC	yes												
03-041	Police	2003	y	y	CRN VIC	yes												
03-045	Police	2003	y	y	CRN VIC	yes												
03-048	Police	2003	y	y	CRN VIC	yes												
03-051	Police	2003	y	y	CRN VIC	yes												
03-052	Police	2003	y	y	CRN VIC	yes												
03-053	Police	2003	y	y	CRN VIC	yes												
03-055	Police	2003	y	y	CRN VIC	yes												
03-067	Police	2003	y	y	CRN VIC	yes												
03-068	Police	2003	y	y	CRN VIC	yes												
03-069	Police	2003	y	y	CRN VIC	yes												
03-073	Police	2003	y	y	CRN VIC	yes												
03-074	Police	2003	y	y	CRN VIC	yes												
03-075	Police	2003	y	y	CRN VIC	yes												
03-076	Police	2003	y	y	CRN VIC	yes												
03-077	Police	2003	y	y	CRN VIC	yes												
03-078	Police	2003	y	y	CRN VIC	yes												
03-079	Police	2003	y	y	CRN VIC	yes												
03-081	Police	2003	y	y	TAURUS	yes	yes											yes
03-115	Police	2003	y	y	AEROSTAR													
03-116	Police	2003	y	y	AEROSTAR													
03-134	Police	2003	n	y	TAHOE	yes	yes											yes
03-230	Police	2003	y	y	EXPEDITION	yes	yes											yes
04-083	Police	2004	y	y	CRN VIC	yes												
04-089	Police	2004	y	y	CRN VIC	yes												
04-098	Police	2004	y	y	STRATUS	yes	yes											yes
04-099	Police	2004	y	y	STRATUS	yes	yes											yes
04-205	Police	2004	y	y	SUV 4X4													
04-501	Police	2004	n	y	BMW													
04-516	Police	2005	y	y	#R1150RT-P													
05-004	Police	2005	n	y	IMPALA													
05-049	Police	2005	y	y	CRN VIC	yes												
05-054	Police	2005	y	y	CRN VIC	yes												
05-058	Police	2005	y	y	4DR SEDAN													

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Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replace ment A	Fleet Replace ment B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
05-072	Police	2005	y	y	CRN VIC	yes												
05-094	Police	2005	y	y	CRN VIC	yes												
05-113	Police	2005	y	y	STRATUS	yes	yes											yes
05-114	Police	2005	y	y	STRATUS	yes	yes											yes
05-125	Police	2005	y	y	STRATUS	yes	yes											yes
05-132	Police	2005	y	y	CIVIC	yes	yes											yes
05-205	Police	2005	y	y	DURANGO	yes	yes											yes
05-298	Police	2005	y	y	SILVERADO	yes												yes
06-007	Police	2006	y	y	CRN VIC	yes												
06-009	Police	2006	y	y	CRN VIC	yes												
06-015	Police	2006	y	y	CRN VIC	yes												
06-017	Police	2006	y	y	CRN VIC	yes												
06-021	Police	2006	n	y	CRN VIC	yes												
06-022	Police	2006	y	y	CRN VIC	yes												
06-039	Police	2006	y	y	CRN VIC	yes												
06-055	Police	2006	y	y	STRATUS	yes	yes											yes
06-060	Police	2006	y	y	CRN VIC	yes												
06-063	Police	2006	n	y	CRN VIC	yes												
06-080	Police	2006	y	y	CRN VIC	yes												
06-100	Police	2006	n	y	CRN VIC	yes												
06-101	Police	2006	n	y	CRN VIC	yes												
06-102	Police	2006	n	y	CRN VIC	yes												
06-103	Police	2006	n	y	CRN VIC	yes												
06-104	Police	2006	n	y	CRN VIC	yes												
06-105	Police	2006	n	y	CRN VIC	yes												
06-106	Police	2006	n	y	CRN VIC	yes												
06-107	Police	2006	n	y	CRN VIC	yes												
06-109	Police	2006	n	y	CRN VIC	yes												
06-114	Police	2006	n	y	CRN VIC	yes												
06-117	Police	2006	n	y	CRN VIC	yes												
06-118	Police	2006	n	y	CRN VIC	yes												
06-119	Police	2006	n	y	CRN VIC	yes												
06-120	Police	2006	n	y	CRN VIC	yes												
06-121	Police	2006	y	y	STRATUS	yes	yes											yes
06-122	Police	2006	n	y	STRATUS	yes	yes											yes
06-123	Police	2006	n	y	TAURUS	yes	yes											yes
06-126	Police	2006	n	y	CRN VIC	yes												
06-127	Police	2006	n	y	CRN VIC	yes												
06-128	Police	2006	n	y	STRATUS	yes	yes											yes
06-133	Police	2006	y	y	STRATUS	yes	yes											yes
06-175	Police	2006	y	y	STRATUS	yes	yes											yes
06-215	Police	2006	y	y	F-350		yes											yes
06-226	Police	2006	n	y	SILVERADO		yes											yes
06-305	Police	2006	n	y	C-1500		yes											yes
06-500	Police	2006	n	y	MOTORCYCLE		yes											
06-506	Police	2006	n	y	BMW													
06-507	Police	2006	n	y	BMW													
06-508	Police	2006	n	y	BMW													
07-001	Police	2007	n	y	CRN VIC	yes												
07-003	Police	2007	n	y	CRN VIC	yes												
07-004	Police	2007	n	y	CRN VIC	yes												
07-008	Police	2007	n	y	CRN VIC	yes												
07-010	Police	2007	n	y	CRN VIC	yes												
07-020	Police	2007	n	y	CRN VIC	yes												
07-030	Police	2007	n	y	CRN VIC	yes												
07-031	Police	2007	n	y	CRN VIC	yes												
07-032	Police	2007	n	y	CRN VIC	yes												
07-042	Police	2007	n	y	CRN VIC	yes												
07-043	Police	2007	n	y	CRN VIC	yes												
07-044	Police	2007	n	y	CRN VIC	yes												
07-061	Police	2007	n	y	CRN VIC	yes												
07-064	Police	2007	n	y	CRN VIC	yes												
07-065	Police	2007	n	y	CRN VIC	yes												
07-066	Police	2007	n	y	CRN VIC	yes												
07-129	Police	2007	n	y	CRN VIC	yes												
07-177	Police	2007	n	y	CARAVAN													
07-290	Police	2007	n	y	F-250		yes											yes
07-291	Police	2007	n	y	F-250		yes											yes
07-502	Police	2007	n	y	MOTORCYCLE													
07-503	Police	2007	n	y	MOTORCYCLE													
07-514	Police	2007	n	y	MOTORCYCLE													
07-515	Police	2007	n	y	MOTORCYCLE													
07-517	Police	2007	n	y	DR2400													
07-520	Police	2008	n	y	ST1300A													
07-521	Police	2007	n	y	ST1300A													
08-046	Police	2008	n	y	AVENGER													
08-169	Police	2008	n	y	NITRO													
08-198	Police	2008	n	y	Police PU 4x4													
08-250	Police	2008	n	y	E-350													
08-297	Police	2008	n	y	SILVERADO		yes											yes
08-518	Police	2008	n	y	HUSTON													
91-237	Police	1991	y	y	SAVANA													
93-423	Police	1993	y	y	49004X2													
94-276	Police	1994	y	y	S-10 PU		yes											
96-068	Police	1996	y	n	CRN VIC													
96-078	Police	1996	y	n	CRN VIC													
97-123	Police	1997	y	y	TAURUS	yes	yes											yes
97-213	Police	1997	n	y	RANGER		yes											yes
99-023	Police	1999	y	y	CRN VIC	yes												
99-026	Police	1999	y	y	CRN VIC	yes												

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replace ment A	Fleet Replace ment B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
99-028	Police	1999	y	y	CRN VIC	yes												
99-029	Police	1999	y	y	CRN VIC	yes												
99-034	Police	1999	n	y	CIVIC	yes	yes											yes
99-490	Police	1999	y	y	SWAT BOX V													
00-241	Public Works	2000	y	y	DAKOTA	yes												yes
00-260	Public Works	2000	y	y	DAKOTA	yes												yes
00-261	Public Works	2000	y	y	DAKOTA	yes												yes
00-263	Public Works	2000	y	y	DAKOTA	yes												yes
00-301	Public Works	2000	y	y	T-800		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
00-303	Public Works	2000	y	y	LT7500		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
00-716	Public Works	2000	y	y	PATCHER B4		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
00-755	Public Works	2000	y	y	BAX 250													
00-833	Public Works	2000	y	y	CNCRET SAW													
01-207	Public Works	2001	y	y	RAM 2500	yes						yes	yes	yes	yes	yes	yes	
01-257	Public Works	2001	y	y	Ram 1500	yes						yes	yes	yes	yes	yes	yes	
01-268	Public Works	2001	y	y	RAM 1500	yes						yes	yes	yes	yes	yes	yes	
01-738	Public Works	2001	y	n	SPRAYER													
01-835	Public Works	2001	y	y	JNSTON 610		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
01-836	Public Works	2001	y	y	JNSTON 610		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
02-029	Public Works	2002	y	y	TAURUS	yes	yes											yes
02-285	Public Works	2002	y	y	SILVERADO	yes						yes	yes	yes	yes	yes	yes	
02-296	Public Works	2002	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
02-685	Public Works	2002	y	y	924G		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-201	Public Works	2003	y	y	C-2500	yes						yes	yes	yes	yes	yes	yes	
03-240	Public Works	2003	y	y	C-2500	yes						yes	yes	yes	yes	yes	yes	
03-241	Public Works	2003	y	y	C-2500	yes						yes	yes	yes	yes	yes	yes	
03-269	Public Works	2003	y	y	DAKOTA	yes												
03-292	Public Works	2003	y	y	C-2500	yes						yes	yes	yes	yes	yes	yes	
03-381	Public Works	2003	y	y	Utility Truck													
03-388	Public Works	2003	y	y	DUMP TRUCK		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
03-403	Public Works	2003	y	y	DUMP TRUCK		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-625	Public Works	2003	y	y	CRK SEALER		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-700	Public Works	2003	y	y	PRESS WASH		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-822	Public Works	2003	n	y	BX-80WH		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-823	Public Works	2003	n	n	BX-80WH													
03-832	Public Works	2003	y	y	RJ-350		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
03-838	Public Works	2003	y	y	EMUL SPRAY													
04-218	Public Works	2004	y	y	S-10 PU	yes											yes	
04-220	Public Works	2004	y	y	DAKOTA	yes											yes	
04-389	Public Works	2004	y	y	C-2500	yes						yes	yes	yes	yes	yes	yes	
05-151	Public Works	2005	y	y	STRATUS	yes	yes										yes	
05-161	Public Works	2005	y	y	STRATUS	yes	yes										yes	
05-219	Public Works	2005	y	y	RANGER	yes											yes	
05-222	Public Works	2005	y	y	RANGER	yes											yes	
05-227	Public Works	2005	y	y	C-3500	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
05-229	Public Works	2005	y	y	RANGER	yes											yes	
05-231	Public Works	2005	y	y	SUV 4X4													
05-871	Public Works	2005	n	y	CRACVAC		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
06-223	Public Works	2006	n	y	C-1500	yes						yes	yes	yes	yes	yes	yes	
06-224	Public Works	2006	n	y	C-1500	yes						yes	yes	yes	yes	yes	yes	
06-258	Public Works	2005	y	y	F-350	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-324	Public Works	2006	y	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-340	Public Works	2006	n	y	F-350	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-341	Public Works	2006	n	y	C-3500	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-342	Public Works	2006	n	y	C-3500	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-343	Public Works	2006	n	y	C-3500	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-346	Public Works	2006	n	y	M2106		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-349	Public Works	2006	y	y	ALTEC LIFT		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
06-643	Public Works	2006	n	y	DD-38HF		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
06-646	Public Works	2006	n	n	SCARIFIER													
06-647	Public Works	2006	n	n	SCARIFIER													
06-732	Public Works	2006	n	y	PRESS WASH		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
06-829	Public Works	2006	n	y	ELGIN ST SWP		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
06-844	Public Works	2006	n	y	DD-28HF		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
07-106	Public Works	2007	y	y	SEBRING													
07-214	Public Works	2007	n	y	COLORADO	yes											yes	
07-224	Public Works	2007	n	y	F-150	yes						yes	yes	yes	yes	yes	yes	
07-242	Public Works	2007	n	y	COLORADO	yes											yes	
07-245	Public Works	2007	n	y	COLORADO	yes											yes	
07-630	Public Works	2007	n	y	430E		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-205	Public Works	2008	n	y	F-250	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-271	Public Works	2008	n	y	F-250	yes											yes	
08-279	Public Works	2008	n	y	F-450	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-300	Public Works	2008	n	y	LTI9500		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-333	Public Works	2008	n	y	F-550		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-336	Public Works	2008	n	y	F-350	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-372	Public Works	2008	n	y	F-350	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-397	Public Works	2008	n	y	7600 SFA 6X4		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
08-680	Public Works	2008	n	y	430E		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-707	Public Works	2008	n	y	W120FT		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-711	Public Works	2008	n	y	JNSTON VT650		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-715	Public Works	2008	n	y	ASPH PAVER		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
08-837	Public Works	2008	n	y	JNSTON VT650		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
09-384	Public Works	1994	y	y	TRK R/LDR		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		
94-673	Public Works	1994	y	n	D-24													
99-106	Public Works	1999	y	y	TAURUS	yes	yes										yes	
99-223	Public Works	1999	y	y	SONOMA	yes											yes	
99-227	Public Works	1999	y	y	SONOMA	yes											yes	
99-232	Public Works	1999	y	y	SONOMA	yes											yes	
99-248	Public Works	1999	y	y	SONOMA	yes											yes	

GHG Reduction Action Plan Analysis

Measure Summary																		
Vehicle No.	Dept	Year	2000 Fleet	2008 Fleet	Model	Fleet Replacement A	Fleet Replacement B	B5	B20	B50	B99	B20 Linked to Repl. A	B20 Linked to Repl. B	B50 Linked to Repl. A	B50 Linked to Repl. B	B99 Linked to Repl. A	B99 Linked to Repl. B	Fleet Mngmt Software Initiatives
99-601	Public Works	1999	y	y	COMPRESSOR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-605	Public Works	1999	y	y	COMPRESSOR			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-711	Public Works	1999	y	y	JNSTON 605			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	
99-831	Public Works	1999	y	n	ROLLER													
S3-321	SM	1990	0	0	SPEC MAINT													
S3-331	SM	1990	0	0	SPEC MAINT													
S4-031	SM	1990	0	0	SPEC MAINT													
S5-531	SM	1990	0	0	SPEC MAINT													
S5-532	SM	1990	0	0	SPEC MAINT													
S6-021	SM	1990	0	0	SPEC MAINT													
S6-022	SM	1990	0	0	SPEC MAINT													
S8-335	SM	1990	0	0	SPEC MAINT													
S8-343	SM	1990	0	0	SPEC MAINT													
S8-344	SM	1990	0	0	SPEC MAINT													
S8-345	SM	1990	0	0	SPEC MAINT													
S8-351	SM	1990	0	0	SPEC MAINT													
S8-421	SM	1990	0	0	SPEC MAINT													
S8-424	SM	1990	0	0	SPEC MAINT													
S8-427	SM	1990	0	0	SPEC MAINT													
S8-431	SM	1990	0	0	SPEC MAINT													
S8-432	SM	1990	0	0	SPEC MAINT													
S8-442	SM	1990	0	0	SPEC MAINT													
S8-551	SM	1990	0	0	SPEC MAINT													
S8-552	SM	1990	0	0	SPEC MAINT													
S8-555	SM	1990	0	0	SPEC MAINT													
S8-614	SM	1990	0	0	SPEC MAINT													
S8-616	SM	1990	0	0	SPEC MAINT													
00-204	NA	2000	y	y	F-150		yes						yes		yes		yes	yes
00-205	NA	2000	y	y	F-150		yes						yes		yes		yes	yes
01-370	NA	2001	y	y	F-350		yes						yes		yes		yes	yes
01-E01	NA	2001	y	n	PRIUS													
01-E02	NA	2001	y	n	INSIGHT													
02-321	NA	2002	y	y	F-350		yes						yes		yes		yes	yes
02-606	NA	2002	y	n	721D MOWER													
06-504	NA	2006	n	y	MOTORCYCLE													
94-386	NA	1994	y	y	ALTEC LIFT		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
95-349	NA	1995	y	n	SIERRA-3500													
95-354	NA	1995	y	y	SIERRA-3500		yes						yes		yes		yes	yes
97-201	NA	1997	y	y	F-250		yes						yes		yes		yes	yes
97-311	NA	1997	y	y	FLTBED/DMP													
98-247	NA	1998	y	y	CARGO VAN													

8.12 Photovoltaic System List

Location	Size: Mega Watts: DC Watts	Cost: DC Watts	Notes
Dry Creek Waste Water Treatment Plant	0.3	\$1,950,000	Ground mount Single axis tracking
Pleasant Grove Waste Water Treatment Plan	0.418	\$2,717,000	Ground mount Single axis tracking
Roseville Energy Park	1	\$6,500,000	Ground mount Single axis tracking
Roseville – Barton Road Water Treatment Plant	0.683	\$4,439,500	Roof mounted Fixed tilt
Roseville Retired Land Fill - Brownfield	1.735	\$11,277,500	Ground mount Fixed tilt
Roseville Downtown Parking Shade Structure	0.16	\$1,040,000	Mount on shade structure Fixed tilt
Roseville – Mahany Park Parking Structure	0.23	\$1,495,000	Mount on shade structure Fixed tilt
Roseville – Corporation Yard – Parking Shade Structure	0.305	\$1,982,500	Mount on shade structure Fix tilt
Roseville – Assorted City Buildings	0.55	\$3,575,000	Fixed tilt Roof mounted
<hr/>			
SUB TOTAL	5.08	\$34,976,500	
Administration and Project Management @ 1% of Total		\$349,765	
GRAND TOTAL		\$35,326,265	

8.13 Photovoltaic System Example Calculation

Example calculation: 500 kWdc fixed axis system

<u>Solar Electric Costs and Benefits Summary</u>		
Net AC conversion	0.77	(net AC watt/gross DC watt)
Inverter replacement cost	824.00	(\$/kWac)
PV Output Degradation	0.5%	(per year)
System Size (DC)	500	kW DC
System Size	405.0	<u>(Net AC Kilowatts)</u>
Configuration	Fixed Axis	
Performance	1,637	<u>(AC kWh/yr per CEC AC kW installed)</u>
Annual kWh (initial year)	556,498	<u>(kWh/yr)</u>
Module Degradation	0.50%	<u>(% / yr)</u>
System Maintenance	0.25%	<u>(% Gross system cost / yr)</u>
Permit	\$1,200	<u>(\$)</u>
TOU Meter and Monitoring (\$443	<u>(\$)</u> \$0
System Cost	\$8.0	<u>(\$/netACwatt)</u> \$1.0
Rebate	\$10,000	<u>Roseville Electric</u>
Final Net Cost	\$2,878,431	<u>(\$)</u>
System Size/kW	100	<u>(sq ft/AC net kw)</u>
Time of Use Factor	1.00	<u>Ave. (\$/kwhr) generation / (\$/kwhr) use</u>
System Area	40,495	<u>(sq-ft flat)</u>
Square System Area	201	<u>(feet on each side)</u>

8.14 Solar Electric Production Assumptions

<u>Solar Electric System Performance</u>	<u>Inputs</u>	<u>Calculations</u>
Module Temp. (PTC) Rating (%)	89%	in Blue
Inverter Efficiency (%)	91%	
CEC AC Rating (%)	81%	(CEC Rating net AC watts/gross DC watts)
Dust & Dirt (%)	7%	
Manufacturer Fudge (%)	3%	
Module Mismatch (%)	1%	
Wiring (%)	3%	
Real AC Performance / DC Rating	68%	
Inverter replacement cost	824	(\$/kWac)
Output Degradation	0.5%	(per year)
Size (DC)	500	kW DC
Size (AC)	405.0	<u>(Net CEC AC Kilowatts)</u>
CEC Performance	1,637	<u>(CEC AC Rating kWh/yr per CEC AC kW installed)</u>
Real Performance	1,374	<u>(Real AC kWh/yr per CEC AC kW installed)</u>
Annual kWh (initial year)	556,498	<u>(kWh/yr)</u>
Module Degradation	0.5%	<u>(% / yr)</u>
System Maintenance	0.25%	<u>(% Gross system cost / yr)</u>
Permit	\$1,200	<u>(\\$)</u>
TOU Meter	\$443	<u>(\\$)</u>
Cost	\$8.0	<u>(\$/netACwatt)</u>
Rebate	\$0.26	<u>(\$/netAC kWh)</u>
Time of Use Factor	0.0	<u>Ave. (\$/kwhr) generation / (\$/kwhr) use</u>
Total Installed Costs	\$3,241,243	<u>(\\$)</u>
Rebate	\$10,000	<u>(\\$)</u>
Final Net Cost	\$3,135,956	<u>(\\$)</u>

8.15 Transit Replacement Costs

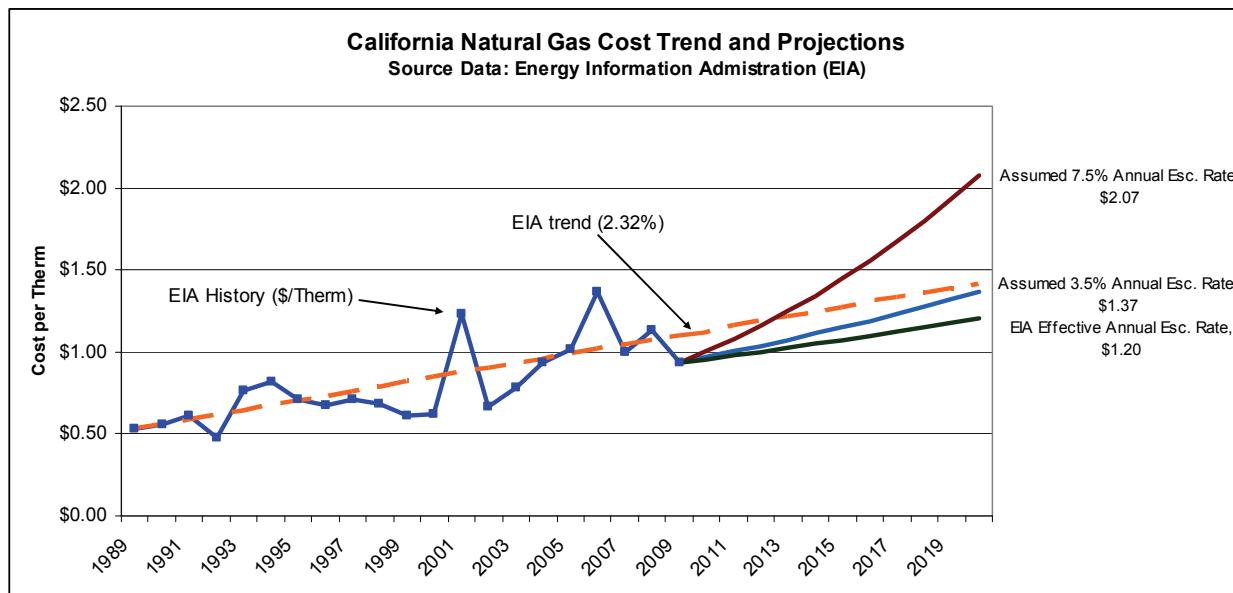
Regional Bus/Van Pricelist FY 2008-09					
Source: Metropolitan Transportation Commission					
	Proposed FY09 Price				
	Total	Federal	Local	Federal %	Local %
Auto	26,000	21,695	4,305	83.44%	16.56%
Minivan Under 22'	48,000	40,052	7,948	83.44%	16.56%
Cut-Away/Van Under 26', 4 or 5-Year, Gas	72,000	58,770	13,230	81.62%	18.38%
Cut-Away/Van Under 26', 4 or 5-Year, Diesel	97,000	79,176	17,824	81.62%	18.38%
Cut-Away/Van Under 26', 4 or 5-Year, CNG	108,640	88,677	19,963	81.62%	18.38%
Cut-Away/Van Under 26', 7-Year, Gas	101,000	83,830	17,170	83.00%	17.00%
Cut-Away/Van Under 26', 7-Year, Diesel	136,000	112,880	23,120	83.00%	17.00%
Cut-Away/Van Under 26', 7-Year, CNG	152,000	126,159	25,841	83.00%	17.00%
Cut-Away/Van 26'+, 4 or 5-Year, Gas	76,000	62,034	13,966	81.62%	18.38%
Cut-Away/Van 26'+, 4 or 5-Year, Diesel	102,000	83,257	18,743	81.62%	18.38%
Cut-Away/Van 26'+, 4 or 5-Year, CNG	114,000	93,052	20,948	81.62%	18.38%
Cut-Away/Van 26'+, 7-Year, Gas	106,000	87,980	18,020	83.00%	17.00%
Cut-Away/Van 26'+, 7-Year, Diesel	143,000	118,689	24,311	83.00%	17.00%
Cut-Away/Van 26'+, 7-Year, CNG	160,000	132,799	27,201	83.00%	17.00%
Transit Bus 30' Diesel	445,000	358,917	86,083	80.66%	19.34%
Transit Bus 30' CNG	498,000	401,665	96,335	80.66%	19.34%
Transit Bus 30' Hybrid	601,000	484,740	116,260	80.66%	19.34%
Transit Bus 35' Diesel	458,000	369,320	88,680	80.64%	19.36%
Transit Bus 35' CNG	513,000	413,670	99,330	80.64%	19.36%
Transit Bus 35' Hybrid	619,000	499,146	119,854	80.64%	19.36%
Transit Bus 40' Diesel	471,000	379,730	91,270	80.62%	19.38%
Transit Bus 40' CNG	528,000	425,684	102,316	80.62%	19.38%
Transit Bus 40' Hybrid	637,000	513,562	123,438	80.62%	19.38%
Over-the-Road 30' Diesel					
Over-the-Road 35' Diesel					
Over-the-Road 40' Diesel	551,000	443,608	107,392	80.51%	19.49%
Over-the-Road 40' CNG	617,000	496,744	120,256	80.51%	19.49%
Over-the-Road 40' Hybrid	744,000	598,991	145,009	80.51%	19.49%
Over-the-Road 45' Diesel	595,000	479,032	115,968	80.51%	19.49%
Over-the-Road 45' CNG	666,000	536,194	129,806	80.51%	19.49%
Over-the-Road 45' Hybrid	803,000	646,492	156,508	80.51%	19.49%
Over-the-Road 60' Diesel	785,000	631,087	153,913	80.39%	19.61%
Over-the-Road 60' CNG	879,000	706,656	172,344	80.39%	19.61%
Over-the-Road 60' Hybrid	1,060,000	852,168	207,832	80.39%	19.61%
Articulated 60' Diesel	667,000	536,223	130,777	80.39%	19.61%
Articulated 60' CNG	747,000	600,537	146,463	80.39%	19.61%
Articulated 60' Hybrid	900,000	723,539	176,461	80.39%	19.61%

Table 31: Metropolitan Transportation Commission Regional Bus/Van Pricelist

8.16 Federal Stimulus Package Projects

<u>Project name</u>	<u>Department</u>	<u>Funding</u>	<u>Source</u>	<u>Energy Savings</u> (annual kWh)	<u>Duration</u>	<u>Analysis</u>
Aquifer Storage Recovery (ASR) well expansion	EU	\$4 M	unspecified	not specified		Potential Local Carbon Offset
Business Solar Energy Installation	RE	\$2.5M	DOE-EEC Block grant	2,539,800	12 months	Included as Measure 61
City Enterprise Asset Management	IT	\$5.1M	DOE	not specified		Not included as a GHG reduction measure
City Facility Energy Efficiency	RE/Cent. Svcs	\$2M	DOE	6,500,000		Included as Measure 4
City High Energy Efficiency and Solar Fire Station	RE/Fire	\$2.25M	DOE	New project		Not included due to quantification issues
City Solar Energy Installation Project	RE	\$35.3M	DOE	included		Included as Individual PV Measures 34 to 49
Direct Load Control Project	RE	\$3.3M	DOE-Grants to State Energy Programs	2,401,545	5 years	Included as Measure 60
Dry Creek Wastewater Treatment Plant Storage Pond	EU	\$7M	unspecified	not specified		Not included as a GHG reduction measure
Energy Efficient Appliance Rebate Program	RE	\$.5M	DOE-Energy Efficient Appliance Rebate prog	1,600,000	36 months	Included as Measure 50
Energy Profiler Online Program Expansion	RE	\$.3M	DOE-Grants to State Energy Programs	not specified		Potential Local Carbon Offset
FOG Receiving Station and Digester improvements	EU	\$10M	unspecified	included		Included as Measure 12
HVAC Maintenance Energy Efficient Program	RE	\$.9M	DOE-EEC Block grant	456,472	36 months	Included as Measure 51
LED Streetlight Project	PW/RE	\$10M	DOE-EEC Block grant	included		Included as Measure 5
Non-Residential Energy Efficiency Programs	RE	\$3.9M	DOE-EEC Block grant	annual savings not specified		Potential Local Carbon Offset
Non-Residential On-site audits	RE	\$600K	DOE-EEC Block grant	9,125,000	36 months	Included as Measure 52
Refuse Truck Hybridization/CNG	EU	\$930K	unspecified	not specified		Included in Measure 17 Fleet Replacement Strategy B
Residential and Commercial Energy Efficiency and Solar Loan funding	RE	\$10M	DOE	46,838,547	5 years	Included as Measure 53
Residential and Non-residential online energy audit tool	RE	\$300K	DOE-EEC Block grant	not specified		Potential Local Carbon Offset
Residential Duct Testing and Sealing	RE	\$7.5M	DOE-EEC Block grant	475,000	48 months	Included as Measure 54
Residential Energy Efficiency Programs	RE	\$3.9M	DOE-EEC Block grant	annual savings not specified		Potential Local Carbon Offset
Residential New Construction M&V Programs	RE	\$3.75M	DOE-EEC Block grant	3,750,000		Included as Measure 55
Residential On-site audit and energy efficiency upgrades program	RE	\$5.0M	DOE-EEC Block grant	5,000,000	5 years	Included as Measure 56
Residential Solar Electric Generation programs	RE	\$7.2M	DOE-EEC Block grant	3,900,000	36 months	Included as Measure 57
Small Business Energy Efficiency Programs	RE	\$1.1M	DOE-EEC Block grant	annual savings not specified		Potential Local Carbon Offset
Smart Grid/Advanced Metering Infrastructure	RE	\$15.5M	DOE-Grants to State Energy Programs	not specified		Potential Local Carbon Offset
Solar Thermal Installation Project (aquatic center)	RE	\$300K	unspecified	included		Included as Measure 1
Vehicle Charging Station	RE/Cent. Svcs	\$250K	DOE-Trans Electrification program	not specified		Potential Local Carbon Offset
Waste Reduction and Recycling Audit	EU	\$75K	unspecified	not specified		Potential Local Carbon Offset
Water Efficiency Upgrade Project (retrofit of parks)	EU	\$2.9M	unspecified	81,783		Included as Measure 59
Water Storage Project (Tank)	EU	\$13M	unspecified	not specified		Not included as a GHG reduction measure
Weatherization Assistance	RE	\$6.75M	DOE-Weatherization	4,125,000	24 months	Included as Measure 58

8.17 Natural Gas Cost Trend from 1989 to 2009 with Projections



California Price of Natural Gas Sold to Commercial Consumers (Dollars per Thousand Cubic Feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	5.28	5.25	5.27	5.16	4.28	4.07	4.63	4.57	4.39	4.35	5.13	5.49
1990	5.56	5.64	5.64	5.29	4.54	4.37	4.40	4.64	4.37	5.03	5.05	5.58
1991	6.08	6.29	6.29	5.60	4.71	5.17	4.88	5.42	4.21	4.09	6.31	5.92
1992	4.80	8.65	5.94	5.93	3.77	3.91	4.39	4.40	4.20	4.53	5.45	5.73
1993	7.66	6.00	6.84	6.08	5.79	6.44	5.12	6.58	5.75	4.92	5.03	5.69
1994	8.16	8.70	8.27	8.28	5.85	7.77	5.42	7.45	7.19	5.68	6.02	6.83
1995	7.11	6.74	6.41	5.98	5.56	5.98	5.68	6.20	6.00	6.04	4.67	7.01
1996	6.74	6.19	6.60	5.99	5.55	5.42	5.50	5.25	5.46	5.68	5.49	6.36
1997	7.12	6.92	6.65	6.04	5.28	6.26	5.85	4.95	5.83	6.64	7.03	6.98
1998	6.80	6.86	7.18	6.76	5.77	6.01	5.59	5.98	5.93	5.73	6.08	6.38
1999	6.15	6.64	5.46	5.88	5.53	5.74	6.00	6.42	6.30	6.69	6.74	6.76
2000	6.20	6.73	6.68	6.29	7.04	6.69	7.57	7.29	7.96	8.52	8.76	10.41
2001	12.35	14.26	14.20	11.58	10.78	9.65	7.32	6.69	5.56	4.67	5.18	5.35
2002	6.61	5.91	5.57	6.14	5.70	5.42	5.50	5.35	5.46	5.84	7.02	7.44
2003	7.85	7.99	8.88	8.88	7.57	7.99	7.85	7.87	8.05	7.53	7.96	8.79
2004	9.37	8.88	8.21	7.29	7.84	8.28	8.25	8.24	7.90	8.08	9.64	9.96
2005	10.18	9.83	9.52	9.31	9.42	9.00	9.48	9.51	10.86	13.10	14.36	13.45
2006	13.69	12.33	11.12	9.81	10.02	9.04	8.94	9.16	9.42	8.14	9.61	10.48
2007	9.99	10.57	10.47	10.22	10.21	10.84	10.84	9.69	9.17	9.55	10.16	10.27
2008	11.37	11.26	11.53	12.67	13.42	13.98	15.83	13.30	11.29	10.54	8.84	9.13
2009	9.36	8.20										

Source: U.S. Energy Information Administration (<http://tonto.eia.doe.gov/dnav/ng/hist/n3020ca3m.htm>)

8.18 Vehicle Fuel Cost Trends

Petrofuel Price Trends and Future

Jim Housman, PE (retired)

11/19/07

There are a number of factors that contribute to the cost of gasoline at the pump. According to the U.S. Energy Information Agency (EIA) the price of gasoline can be broken down as follows:

Crude Oil:	64%
Refining (including additives)	13%
Distribution and Marketing	9%
Taxes:	14%

It should be clear from the attached graph that the major factor driving gasoline prices is the price of crude oil. There have been two distinct issues driving the price of crude in the past five years, geo-political issues and geological issues.

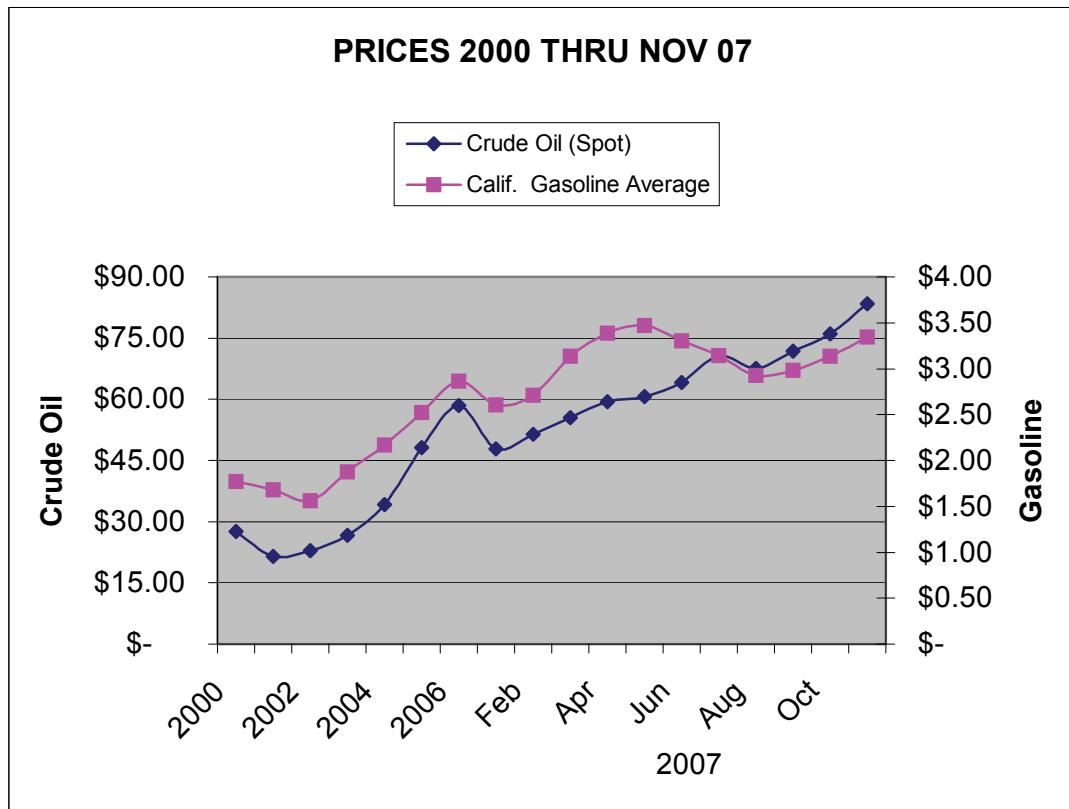
The geo-political issues driving oil prices are primarily the declining value of the dollar, the rapid growth in demand, primarily in Asia, and the economic uncertainty caused by military conflict. An additional geo-political factor is the shift in oil resources from the control (primarily) of privately owned multinational oil companies to being owned and managed by national oil companies. The motivation of shareholder owned companies is largely short term profits, driving the producers to produce the maximum amount of oil in the shortest time. National oil companies, while depending on oil revenue for investment capital, may be motivated to invest a significant portion of their income in non-oil related programs decreasing their ability to increase production as existing oil fields decline. Oil can also be used as a diplomatic tool, punishing enemies and rewarding friends. Short term decisions made by national oil companies for political reasons may have long term economic effects on oil using societies.

Geologically the oil industry is shifting from an environment where a relatively small number of oil fields are each producing very large quantities of oil to one where a very large number of oil fields are each producing a relatively small amount of oil. For example twenty years ago there were 15 oil fields in the world producing over one million barrels per day. Today there are only four, and at least one of those fields (Cantarell in Mexico) is in significant decline. Two thirds of the fields in the oil producing nations in the world are in decline. Not a single field discovered in the past ten years is capable of producing a million barrels per day. (reference 4)

In 1987, after the oil industry recovered from the turmoil caused by the Iran revolution, the price of gasoline in the United States averaged under 70 cents per gallon. In that same year the spot price of crude oil (the price quoted in the news) was about \$13.40. In November of 2007 those prices were \$3.40 for gasoline in California and \$83.03 for crude oil.

In planning for future energy costs we can extrapolate these numbers to estimate gasoline cost in 2008 and future years.

In the simplest terms the cost of gasoline has grown, on average, at about 8% a year over the past twenty years. However if we look at just the past five years, from 2002 to 2007, the price of gasoline has escalated more like 17% each year. In 2012 the difference between those growth rates will be the difference between gasoline at \$5.00 per gallon or \$7.45 per gallon. Given the political and geological issues faced by the oil industry it would be prudent to assume that oil prices will continue their upward momentum.



Sources:

1. <http://publications.uu.se/abstract.xsql?dbid=7625>
2. http://tonto.eia.doe.gov/dnav/pet/pet_pri_wco_k_w.htm
3. http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_a_epm0_pte_cpgal_w.htm
4. <http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp>
5. <http://www.simmonsco-intl.com/files/giantoilfields.pdf>

8.19 Carbon Credits

Carbon Offsets/Green Tags

Prepared by Peter Spencer

The David Suzuki Organization defines a carbon offset as “an emission reduction credit from another organization’s project that results in less carbon dioxide or other greenhouse gases in the atmosphere than would otherwise occur. Carbon offsets are typically measured in tons of CO2-equivalents (or ‘CO2e’) and are bought and sold through a number of international brokers, online retailers, and trading platforms.”

http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_offsets.asp

A green tag is a specific type of carbon offset also referred to as Renewable Energy Certificates (RECs). According to the Environmental Protection Agency, “Renewable Energy Certificates represent the environmental, social, and other positive attributes of power generated by renewable resources.”

The carbon offset is a generic term for all types of purchasable GHG reduction programs sold in the market. For example, CO2 emissions can be offset by paying a group to plant trees anywhere in the world. The green tag, a subset of carbon offsets, is specific to electricity generation. To offset CO2 emissions with a green tag, a purchase is made which supports renewable electricity generation and consumption somewhere else. That green-generated electricity becomes part of the total pool of power and thereby reduces emissions from overall electricity production.

Individuals and organizations can purchase carbon offsets to reduce climate impacts from their activities. When carbon emissions are too difficult or costly to avoid, it’s possible to pay someone else to reduce GHG. Dozens of companies, both commercial and nonprofit, offer a variety of offset types and prices.

The most common type of offset involves trees, either reforestation or avoided deforestation. Other common offsets are renewable energy and energy conservation projects. Prices for offsets/green tags vary widely from \$3.56 to \$30.00 per metric ton. (See survey in appendix) These prices are low compared to many other mitigation measures.

Renewable energy offsets, sold as green tags, fund wind, solar, biomass, and biodiesel projects worldwide. For every megawatt of power produced by a renewable source, one green tag is issued to the producer. The green tags can be sold to raise profits from renewable energy generation thus making it more competitive in the market. Energy conservation offsets often involve purchasing a GHG emission allowance from a company on the Chicago Climate Exchange. This “retires” the allowance preventing others from purchasing it to emit GHG.

Verification and accounting systems for offsets differ and there are currently no accepted standards. There is a wide variation of GHG baseline calculations for activities and also for the calculations of GHG reductions from projects. However, many providers make a good effort to ensure their product’s value and provide documentation. The Green-e program is the most accepted certification program and referenced by the EPA. (<http://www.green-e.org/>)

Arguments in favor of Carbon Offsets:

- Supports growth of the renewable energy industry
- Compensates for GHG emissions which are too difficult or costly to avoid
- Lowers cost of GHG reductions
- Provides a market-based system for GHG reduction
- Can benefit poor countries with investments
- Positive PR for organizations that reduce emissions
- Raises awareness and encourages public policy changes

Sources of supportive information:

An excellent resource for consumers with ratings for top providers:

A Consumer's Guide to Retail Offset Providers

Clean Air-Cool Planet:

<http://www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf>

EPA description of various green purchasing options:

Guide to Purchasing guide for Green Power

Environmental Protection Agency:

http://www.epa.gov/greenpower/pdf/purchasing_guide_for_web.pdf

Realistic assessment supportive of offsets with large number of links:

How the Retail Carbon Offsets Market Can Further Global Warming Mitigation Goals

EM Market Insights:

http://conserveonline.org/workspaces/climate.change/carbonmarkets/em_going_carbon_neutral.pdf

Arguments against Carbon Offsets:

Trees:

- Trees store carbon, but don't reduce total biological carbon brought to the earth's surface in fossil fuels
- Planting releases carbon from the soil
- An unrealistic amount of trees would need to be planted to be effective
- Most projects are planting monocultures causing ecosystem problems
- Predicting the carbon performance of trees is not possible
- Increasingly challenged by scientists as unsuccessful strategy

All methods:

- Don't address the fundamental problem of emissions
- Makes it easy to avoid measures reducing emissions
- Removes money from local economy
- Poor accountability
- No proof that there is an overall improvement in the climate with offset system
- Short-term solution with little direct benefit to offset purchasing organization
- May ignore local problems such as air pollution or need for more power plants
- Questionable future of unregulated and unproven strategies in new offset industry
- Doesn't create lasting benefit for organization

Ecobusinesslinks.com Carbon Offset Survey						
Carbon Offset Provider	Price (US\$/Metric	Non-profit	Projects Types	Project Choice	Offset Types	Product Certification/Verification
AtmosClear Climate Club US	\$3.56 ^a - \$25.00	No	Methane	No	Car, Home	Environmental Resources Trust
Carbonfund.org US	\$4.30 ^b - 5.50	Yes	Renewables, Efficiency, Reforestation	Yes	Home, Car, Air, Events, Business	Green-e, Chicago Climate Exchange, Environmental Resources Trust
e-BlueHorizons US	\$5.00	No	Renewables, Reforestation	No	Home, Car, Air	Chicago Climate Exchange, Environmental Resources Trust
Terrapass US	\$7.35 ^c - 11.00	No	Renewables, Efficiency	No	Car, Air, Events, Business	Green-e, Chicago Climate Exchange, Center for Resource Solutions
DriveNeutral.org US	\$7.50 & up	Yes	Efficiency	No	Car	Chicago Climate Exchange
Native Energy US	\$13.20	No	Renewables	Yes	Home, Car, Air, Events, Business	Green-e
The CarbonNeutral Company UK	\$14.00-18.00	No	Renewables, Efficiency, Reforestation	Yes	Business, Home, Car, Air, Events	KPMG, Edinburgh Centre for Carbon Management, Independent Advisory Committee
Climate Friendly Aus	\$16.00-19.00	No	Renewables	No	Home, Car, Air, Business	Office of the Renewable Energy Regulator, NSW Government, Ernst & Young.
Sustainable travel International US, Switzerland	\$18.00	Yes	Renewables	No	Air, Car, Home, Hotel	See Myclimate
Bonneville Environmental Foundation US	\$29.00	Yes	Renewables	No	Home, Air, Business, Event	Green-e
Myclimate Switzerland	\$30.00	Yes	Renewables	No	Air, Events, Business	Designated Operational Entity
Global Cool UK	£20.00 (\$39.48)	Yes	Renewables, Efficiency	No	n/a	CDM
Services for which independent product certification or verification information not available						
Carbon Offset Provider	Price (US\$/Metric ton CO2)	Non-profit	Projects Types	Project Choice	Offset Types	Product Certification/Verification
DrivingGreen Ireland	\$8.00	No	Renewables	No	Car, Air, Events	n/a
Solar Electric Light Fund US	\$10.00	Yes	Renewables	No	External Calculators	n/a
Carbon Clear UK	\$17.00	No	Reforestation	No	Home, Car, Air, Babies	n/a

a: Atmos Clear - Low price for 25 Ton option at \$89
b: Carbonfund.org - Low price for ZeroCarbon tags option: 18 Ton + 5 Ton match, pay \$99 for \$23 Ton
c: Terrapass - Low price when purchasing 204 metric ton of carbon offsets for \$1,499.95

1. Offset Types: There are hundreds of potential offset types. We have limited our survey to just the most common.
2. Verification: "n/a" means we were unable to determine a third-party verification body. The projects may, however, be verified.
3. Choice: refers to whether customers may choose between project types and/or specific projects.
4. Price: prices change and exchange rates fluctuate. The data listed was first gathered from the respective websites July 21, 2006
5. Other offset providers may exist. This survey provides a cross section of the industry, projects may be added or removed over time.
6. Some information may be incomplete or has changed. We welcome updates.

Sources of Offset critical information:

The most complete, well-written analysis of climate science and offsets: Carbon Trading: A Critical Conversation on Climate Change, Privatization and Power

Dag Hammarskjöld Centre:

http://www.dhf.uu.se/pdffiler/DD2006_48_carbon_trading/carbon_trading_web.pdf

Excellent analysis from a sustainability perspective:

The International Challenge of Climate Change

United Kingdom, Environmental Audit Committee:

<http://www.defra.gov.uk/environment/climatechange/pubs/eac/pdf/cc-govres.pdf>

Scientific paper explaining why reforestation won't help climate change:

Planting trees will not cancel out climate change:

Nature:

<http://www.scidev.net/pdffiles/nature/nature04486.pdf>

Short negative view of green tags:

The wooly world of green tags

out of Kirby Mountain:

<http://kirbymtn.blogspot.com/2006/04/woolly-world-of-green-tags.html>

In-depth assessment of trading systems and their limitations:

Is the US Experience with Pollution Markets Really an Argument for Global Carbon Trading?

McGill International Journal of Sustainable Development, Law and Policy, fall 2005:

http://www.fern.org/media/documents/document_3657_3658.pdf

Good short summary of why offsets don't work:

Carbon 'offset' - no magic solution to 'neutralize' fossil fuel emissions

Forests and the European Union Resource Network:

http://www.fern.org/media/documents/document_884_885.pdf

Strong short letter opposing carbon trading:

We must reduce fossil fuel use, not trade carbon:

Financial Times:

http://www.fern.org/media/documents/document_3634_3635.pdf

(Source: http://www.ecobusinesslinks.com/carbon_offset_wind_credits_carbon_reduction.htm)

For the most complete and up to date list of green tag products and marketers, visit the Green Power Network, part of the U.S. Dept of Energy, Energy Efficiency and Renewable Energy Office.

<http://www.eere.energy.gov/greenpower/markets/certificates.shtml?page=0>

For a detailed report on the status of green power marketing, check out the following publication from the National Renewable Energy Laboratory:

<http://www.eere.energy.gov/greenpower/resources/pdfs/40904.pdf>

8.20 Electric Vehicles

Electric Vehicle Current Status

Jim Housman, P.E. (retired)

May 7, 2007

Battery powered electric vehicles pose opportunities for cost savings and enhanced convenience in an increasing number of applications where their unique properties can be used to advantage. While gasoline as a motor fuel has significantly higher energy density and lower cost per unit of energy, when the overall “well-to-wheel” efficiencies of electrical power are taken into account it can be advantageous to operate electrical vehicles in place of their gasoline or diesel counterparts.

The majority of electric vehicles available today, not including hybrids, are classified as “Neighborhood Electric Vehicles” (NEV). In general these vehicles are limited to a top speed of 25 miles per hour and are only permitted on public roads with speed limits below 35 miles per hour. They have minimal requirements for lighting and passenger protection in keeping with their low speed nature. Some of the larger manufacturers of NEVs are listed on the following web site:

http://www.eere.energy.gov/afdc/afv/elec_vehicles.html

In a recent study (2001) the Department of Energy⁷⁵ evaluated the performance of 348 NEVs operated in 15 automotive fleets. The fleets included in the study belonged to military, commercial, least expensive NEVs, resembling golf carts can be purchased for less than \$5000. Used but functional vehicles are generally available under \$1000.⁷⁶ Because of the simplicity of the electric power train vehicle maintenance costs are a fraction of that required for gasoline or diesel engines. There is no oil to change, no sparkplugs, filters or coolant issues. The light weight of most electrical vehicles also means that brakes, tires and suspension components are very durable.

Currently one of the most conventional appearing NEVs is the Zenn. While still relying on traditional lead-acid battery technology the Toronto Canada based company has created an unusually sophisticated NEV using a small urban vehicle built in France and converted in Canada to electric power. Because of the volume production already in place with the basic car (originally diesel powered) Zenn has managed to price the vehicle just above the “golf cart” market while delivering a vehicle with both the style and convenience of a small gasoline powered vehicle.

The majority of NEVs currently on the market use technology that has not changed significantly for the past half century. They use lead-acid batteries, DC motors and simple control systems. A new regime of electrical vehicles are appearing in the market in the very near future, most likely prompted by the rapidly increasing price of fossil fuels and the increased awareness of Americans that our access to fossil fuels is becoming precarious. One of these new electrical vehicles, the Tesla roadster, is a technological showcase in the form of a high performance

⁷⁵ <http://avt.inel.gov/pdf/nev/nevstudy.pdf>

⁷⁶ <http://www.eaaev.org/eaalinks.html>

sports car. Another, the Phoenix SUT (sport utility truck), also uses state-of-the-art technology in a practical utility vehicle.

Both vehicles use sophisticated AC motors, Lithium ion batteries, heat pump HVAC systems, regenerative braking and computerized control systems. Both are advertising operating ranges of over 100 miles on a single charge and, based on the battery technology, charge times of under 30 minutes should be expected. Early test data on both vehicles describe performance equal to comparable gasoline powered vehicles. In the case of the Tesla roadster that means acceleration to 60 miles per hour in less than 6 seconds and a top speed of 130 miles per hour.⁷⁷ The Phoenix SUT boasts a 1000 pound payload, 90 mile per hour top speed and 60 mile an hour in less than 10 seconds

and low energy density prevented the development of electric vehicles even moderately competitive with liquid fueled vehicles. In the late 1990s electric car and hybrid-electric car developers began investigating the advances made in battery technology for use in portable computers and other electronic devices.

The first of these technologies evaluated for vehicle use was the Nickel-Metal Hydride battery. This battery was promising enough to be used in the second generation EV1 electric car developed by General Motors for compliance with the proposed California Zero Emissions Standard. While not significantly lighter than the lead-acid battery it replaced, the increased energy-to-size ratio allowed for a significantly increased range for the EV1.

Since that time electric car enthusiasts have turned their attention to the Lithium ion battery. These batteries have both significantly better energy-to-weight and energy-to-volume municipal, rental and transportation organizations. The NEVs were found to be successful replacements for gasoline powered vehicles in most circumstances. Success was indicated by satisfied users, improved economy and reliability of the vehicles.

The study did find some areas where improvements could be made. Higher speed capability and improved range were listed as desirable. In addition users would have liked improved passenger protection, including solid doors and roll down windows. Both were lacking in the majority of the fleet vehicles. While the study found that 91% of the vehicles had operated without problems there were some reliability issues. Fourteen vehicles had battery packs replaced, Five had problems with switches and four controllers were replaced.

By a large majority the study found that fleet owners were satisfied with the performance of their vehicles. Some were used only on public roads, some were never used on public roads and some were used under both circumstances. Specific uses included police work, material handling, towing, personnel transportation and community shopping uses.

A large market currently exists for this type of vehicle permitting competitive pricing. The most sophisticated of the NEVs retail in the \$10 to \$15 thousand dollar range. At the higher end of this range will be found vehicles with features and styling that compare favorably with conventional automobiles but lacking only the gasoline engine performance. The simplest and characteristics. Early versions of these batteries were sensitive to high discharge rates and to certain manufacturing defects which resulted in a number of fires occurring in portable computers using this technology. Since that time changes in the cathode material, manufacturing improvements and the development of external control methods have potentially eliminated the problem. As a result a new wave of enthusiasm for electric vehicles is

⁷⁷ <http://www.teslamotors.com/>

developing. Both the high performance Tesla Roadster sports car and the Phoenix Sport Utility Trucks (SUT) are designed around the latest versions of the Lithium ion battery.⁷⁸

Phoenix Motorcars plans to sell approximately 500 Sport Utility Trucks in 2007 to selected fleet operators. One such operator is Pacific Gas and Electric, the northern California utility company. Phoenix plans to begin selling to individual users in 2008 and estimates that it will sell 6000 vehicles in that year. Pricing for the 2008 model year should be in the \$40 to \$50 thousand range.⁴ First shipments of the Tesla Roadster are scheduled for August 2007.

Technological changes are appearing rapidly. Recently EEStor, a Texas company has announced a breakthrough battery/ultra-capacitor system that may leapfrog the Lithium ion battery technology with improved storage capacity, discharge rate and cost. Zenn motorcars has signed an exclusive agreement with EEStor to provide storage systems for their next generation of electric vehicles⁷⁹. Regardless of the success of such efforts it is an indication of a growing interest in non-fossil fueled power systems.

For short distance, light load applications electric powered vehicles are the right choice for a large number of applications. The long charging times needed by lead-acid batteries limit the application of these vehicles to under fifty miles per day in most cases. For those fleet applications that can justify the high first cost Phoenix Motorcars SUTs are a practical vehicle available this year. With the rapid changes taking place in battery, motor and motor controller technologies look for increased choices in the zero emission vehicle market.

While these vehicles are especially designed for specific audiences they represent logical entry points for new technologies into an existing, mature, market. The Tesla roadster is aimed at the wealthy car enthusiast who is willing to pay above market price for the uniqueness of an electric powered performance car. The Phoenix is marketed to fleet purchasers who value their environmental image above the short term ownership cost. Success in these two markets will work as both test beds for these technologies in real operating environments and as bootstrapping operations to bring down the cost of these technologies as production volumes increase.

For the past one hundred years battery technology has been the limiting factor in keeping electric powered vehicles from competing with fossil fuel powered vehicles. For most of this time the only practical battery technology for use in electric cars was the same lead-acid battery used for starting power in conventional automobiles. The combination of high weight, slow recharging,

⁷⁸ <http://en.wikipedia.org/wiki/Altairnano>

⁷⁹ <http://www.technologyreview.com/Biztech/18086/page1/>

Further Reading

The GM EV1:

<http://www.thejaffes.org/rory/ev1/ev1.pdf>

The French postal service plans to order 10,000 electric vehicles:

<http://www.autobloggreen.com/2007/04/18/the-french-postal-service-plans-to-order-10-000-electric-vehicle/>

Nissan and NEC to produce electric-car batteries:

<http://www.detnews.com/apps/pbcs.dll/article?AID=/20070413/UPDATE/704130433/1148/rss25>

Electric car batteries might serve as reservoirs of green power?:

http://www.edn.com/index.asp?layout=blog&blog_id=1470000147&blog_post_id=1170007917

Basic battery technology:

<http://www.batteryuniversity.com/index.htm>

Battery data:

http://en.wikipedia.org/wiki/Nickel_metal_hydride_battery

http://en.wikipedia.org/wiki/Lithium_ion

http://en.wikipedia.org/wiki/Lead_acid

Specs on Altair nano battery:

http://www.altairnano.com/documents/NanoSafe_Datasheet.pdf

Johnson Controls reveals new hybrid-electric car batteries:

<http://wistechology.com/article.php?id=1485>

Altairnano lithium ion battery system:

<http://www.azonano.com/news.asp?newsID=1967>

Safety of lithium ion batteries:

http://www.technologyreview.com/read_article.aspx?id=17250&ch=biztech

Lithium ion battery improvements:

http://www.technologyreview.com/read_article.aspx?id=16384&ch=biztech

8.21 Commute Programs

Commute Programs: Examples of Success

6/17/07

Jim Housman, PE

The United States of America consumes 9.2 million barrels of gasoline every day, approximately 25% of all the gasoline consumed in the world.⁸⁰ Yet the United States contains only 4.5% of the world's population. We drive bigger vehicles and we drive them farther each year than any other society. We have the cheapest gasoline of any nation that imports more petroleum than it exports (excepting China and Thailand)⁸¹. Americans are used to using their cars for virtually 100% of their transportation needs. We have built our cities, and even our small towns, around the assumption that everyone who wants to go anywhere will drive. Our driving has been cheap and convenient. But in recent years that has begun to unravel. As our homes have become farther away from our workplaces and as our need to import oil has increased driving has become more and more expensive and more irksome. And in spite of spectacular efforts to reduce pollution our driving has continued to be a major factor in environmental degradation.

Slowly over time these factors have been at the root of a change in behavior that is taking place all over the continent. In all 50 states, and in Canada, programs are arising to limit the number of automobiles on the road during peak driving hours. A number of states have established transportation demand management (TDM) legislation to reduce public road usage. In addition, local governments have established regional traffic mitigation programs to assist local employers in encouraging their workforce to stop driving to work alone. Often these programs enable groups of employers to share incentives and facilities to enhance the commuter experience while reducing costs for both employer and employee. California has no state wide traffic mitigation program, however the recently passed AB1431 (Vehicle Greenhouse Gas Emissions) will almost certainly address the effects of commuting on greenhouse gases.

The US Department of Transportation has created a program dubbed "Best Workplaces for Commuters" (BWC) to acknowledge those employers that have done the most to make alternate commute options work the best for their employees. As of June 2007 the site has over 1,400 employers listed as meeting the department's stringent standard for inclusion on the list. Typically to win acknowledgement employers must provide emergency ride home capabilities for transit and car/van pool commuters, provide some kind of subsidy or support for those not driving to work alone and commit to having 14% of employees participate in the program within 18 months. In addition to the BWC program the Internal Revenue Service permits employers to pay for certain commute benefits with pre-tax dollars, saving money for both employers and employees.⁸²

Commute programs exist at the federal, state, county and jobsite levels because they work. In a survey funded by the US Department of Transportation (DOT) in 2004 found that well designed commute programs reduced vehicle trips by an average of 15.3%.⁸³ That kind of

⁸⁰ <http://www.eia.doe.gov/neic/quickfacts/quickoil.html>

⁸¹ <http://europe.theoldrum.com/node/2653>

⁸² <http://www.bwc.gov/>

⁸³ Mitigating Traffic Congestion; Association for Commuter Transportation; PO Box 15542, Washington, DC 20003-0542;2004

reduction pays off. It pays off in savings to the employer, government at all levels and the employee.

Most employers are probably so accustomed to providing parking spaces for employees that it is not considered to be a real cost of doing business. Yet some employers must set aside more land for parking than is used for generating income. The Victoria (B.C.) Transport Policy Institute estimated in 2000 that parking lot construction costs can vary between \$1500 (US) and \$1900 (US) per space. That cost is in addition to the value of the unimproved land. When parking structures become necessary per space costs can exceed \$9000 per space. In addition there are annual maintenance costs.⁸⁴ One estimate of the value to U.S. employers of this unproductive land placed the rental value nationwide at over 35 billion dollars.⁸⁵

DOT estimates that current freeway construction costs exceed one-quarter million dollars per lane-mile with a continuing cost of about one percent of that amount for annual maintenance. While this cost is not apparent directly to the taxpayer it is there and as more roadways are constructed to accommodate peak traffic loads for commuters both the capital costs of construction and the annual maintenance costs are an increasing burden on taxpayers and on the local officials who must negotiate to find the funds.⁸⁶

Commute costs to employees is more than the obvious. A UC Berkeley study in 1990 indicated that the average Bay Area one-way commute distance increased between 1980 and 1990 from 10.6 miles to 11.8 and the average duration from 27.7 minutes to 29.0 minutes. Over a 50 week working year that amounts to 5900 miles per year and 242 hours on the road. With per-mile driving costs approaching 50 cents employees are spending almost \$3000 per year just to get to work. Since employers do not pay for the time that commuters sit in their cars in heavy traffic it is the individual worker whose time is wasted crawling through traffic. According to the Texas Transportation Institute California commuters who have recently moved to a metropolitan area spend, on average, 250 hours per year in commuter traffic.

There are great success stories in communities developing programs to reduce vehicle miles traveled (VMT). Boulder, Colorado has a program called Ride Arrangers that reports having saved 28 million VMT in 2006. Ride Arrangers has 6,000 people in their carpool database, 380 people vanpooling with a waiting list to fill 10 more vans. There are 4,000 "teleworkers" and 11,000 families enrolled in the "schoolpool" database. In the annual Bike to Work Day in 2006 there were 20,000 participants.⁸⁷

In the Bay area Contra Costa county reports that their SchoolPool program has reduced VMT by 4 million miles in 2002⁸⁸. The San Mateo County Commute Alternatives Program has mailed 80,000 Commuter Checks to employees of 3,200 employers in the county since 1991.⁸⁹ C2HM Hill reports a 115,000 mile reduction in VMT in 2002 at a single worksite in Denver. In Seattle

⁸⁴ Todd Litman; Parking Management Strategies, Evaluation and Planning; Victoria Transport Policy Institute; 2006

⁸⁵ http://72.14.253.104/search?q=cache:biyCdgRbNHQJ:www.commuterchoice.gov/pdf/sanfran/bwc-present-sfa.ppt+sonoma+best+workplaces&hl=en&ct=clnk&cd=2&gl=us&lr=lang_en

⁸⁶ [http://www.publicpurpose.com/hwy-fy\\$.htm](http://www.publicpurpose.com/hwy-fy$.htm)

⁸⁷ Linda Dowlin, Denver TDM Manager; personal communication; 6/11/07

88 <http://www.smccap.org/index.jsp>

the University of Washington estimates that the UPASS program has eliminated 91 million vehicle trips since it was established in 1991⁴. These examples show that in a large variety of environments and over long periods of time employers, employees, taxpayers and the environment are benefiting from well designed commute programs.

Today, more than ever in the past, it makes sense to create programs allowing commuters to get out of their cars and find more appropriate ways to get to and from work. The ability of the modern passenger vehicle to take us anywhere we want, when we want is at its least beneficial when we are traveling the same path at the same time of day over many months and years. The rising cost of operation, the increasing time spent unproductively and the anger and frustration so often connected with present day commuting will continue to get worse in the future. We cannot pave the entire nation to enable every person to drive effortlessly where ever they want to go at any time of day. It follows that community leaders in every American community should be emulating the examples of those communities that have gained so much by instituting these programs.

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17. <http://www.commuterchallenge.org/cc/daw99acordia.html>
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19. Ride Solutions; Mid Ohio Regional Planning Commission; <http://ridesolutions.morpc.org/>
20. City of Palo Alto Way 2 Go Program; <http://www.city.palo-alto.ca.us/transportation-division/commute-index.html>
21. Washington D.C.; Capital Rideshare Program; <http://capitolrideshare.com/index.htm>

Examples of Successful Programs

Program name	Location	Demographics	% of Transit Population Participating											BWC(@)	% Participating	Control (\$)
			Car pool	Van pool	Transit pass	Car/Van Parking	Guaran. Ride Home	Tele commute flextime	Work week	Shuttle	Bicycle/Walk	Other				
Upass	U. of Washington	39,000 students	x		x	x								Yes		Univ.
SchoolPool	Contra Costa Cty, CA	157,000 students	x		x									No		County
Transportation Options	Aspen, CO	15,000 residents	x			x				x				Yes		Blanket
TNT/TMA	Lake Tahoe Basin	56,000 residents, large tourist influx			x							x		No		Govt
Vanpool Program	Bal Harbour Village, FL	3309 pop.		x										Yes		Govt
Calibre Transportation Benefits	Alexandria, VA	na	x		x			x			x	x		Yes		Corp
C2Hill Telework & Flextime	Denver, CO	na	5.0%		3.0%			8.0%			0.5%			No	16.5%	Corp
Georgia Power Smartride	Atlanta, GA	5,500 employees	7.0%	6.0%			x	20.0%		x				Yes	33.0%	Corp
Transit Plan	Hennepin County, MN	13,000 county employees	15.0%	2.0%	15.0%			8.0%						Yes	40.0%	Blanket
Johns Manville tbp	Denver, CO	est. 400 empl Denver only	x	0.5%	44.0%	x						0.5%		Yes	45.0%	Corp
Nike TRAC Program	Beaverton, OR	5,000 employees	10.0%		5.0%		x	5.0%			2.0%	Prizes	Yes	22.0%	Corp	
Overlake Christian Church tbp	Redmond, Wash	109 employees	26.0%		1.0%			12.0%	8.0%		1.0%			No	48.0%	Corp
Simmons College tbp	Boston, MA	740 faculty & staff			27.0%		x			x			32.0%	Yes	59.0%	Corp
Swedish Medical Center tbp	Seattle, WA	758 staff & dr	19.0%	2.0%	23.0%	x	x	2.0%	x					Yes	46.0%	Corp
Texas Children's Hospital tbp	Houston, TX	758 staff & dr	10.0%		10.0%	x	x	x		x				Yes	20.0%	Corp
King County TOD	Seattle, WA	metro Seattle	x		x	x						car share	No		Blanket	
Acordia Northwest Inc.	Seattle	118 employees	x	x	x		x	x						No		Corp
GO Boulder	Boulder, CO	County employees	x	x	x		x	x			x	4100 bikers, walkers, transit riders	No		Blanket	
Commute Alternatives Program	San Mateo, CA county	City and surrounding area	x	x	x	x	x							Yes		Blanket
Ride Arrangers	Denver, CO	School, city & business employees	x	x			x	x			x			No		Blanket
GoGreen	Vancouver BC	906,000 pop	x	x	x			x			x			No		Blanket
Smart Commute Program	Westchester County, NY		x	x	x	x	x	x	x					Yes		Blanket
CTR	Redmond Wash	23,500 pop												No		Blanket
RideSolutions	Mid-Ohio Regional Planning Comm.	11 counties around Columbus, OH	x	x	x		x				x			No		Blanket
Employee Commute Program	Palo Alto		x	x	x		x			x	x			No		Blanket
Travel Reduction Program	Greater Tucson area	486669	x		x						x			No		Blanket
Capital Rideshare	Phoenix, AZ	4,000 state employees plus 50 companies.	x	x	x	x	x	x	x	x	x			No		Blanket

This program is an umbrella function for all Wash state programs

Commute Trip ReductiState of Wash

This program is an umbrella function for all Wash state programs

MassRides State Of Mass.

*Note corp participation is voluntary so financial benefits are at employer discretion

\$ Control refers to the type of organization sponsoring the program.

Blanket refers to a government sponsorship organization that helps other organizations to form commute programs.

© BWC= Listed on federal program called "Best Workplace for Commuters"

8.22 Grease to Gas Augmentation of Digester Gas

“Grease to Gas”

Restaurant Trap Grease Collection and Augmentation of Digester Gas

Excerpts from Riverside “Project Description” Document dated 4/17/07

Jim Housman, PE (retired)

4/17/08

Summary:

1. Capital cost apparently very low due to use of contracting company picking up and delivering waste to facility. Total expenditures for labor, equipment and laboratory analysis were \$85,000 at time of report minus a potential \$16k grant from the PUC.
2. Because the city already operated a treatment facility with methane capture, capital investment was only required to adapt the existing system to accept the waste grease.
3. The additional amount of methane gas generated by the addition of the grease wastewater has been as high as 493,000 cubic feet. This is the same as 4,930 therms of natural gas.
4. City receives \$6500/mo. in disposal fees from delivery company (\$21,000 in 2007)
5. Sewage systems overflows caused by grease trap problems was reduced
6. Biosolids production in the city’s digesters was reduced saving \$48,000/month
7. Fuel savings obtained at the site were as high as \$85,000/mo.
8. Total savings were over \$1M for 9 months.

The city of Riverside, California operates a publicly owned treatment works (POTW) capable of handling 40 million gallons per day. The treatment process is fully tertiary utilizing anaerobic digestion and treats an average daily flow of 35 MGD. The City’s POTW has a cogeneration facility that has the capability of generating about 3 megawatts of power. This cogeneration facility has three internal combustion (IC) engines that use the methane gas produced by the digesters as a fuel source. In addition to the IC engines, the City will be installing a one-megawatt fuel cell that will use digester gas to produce electrical power.

The City’s Public Utilities Department (PUD) was informed of the Grease to Gas project and was quite interested due to the renewable energy source created by the processing of the grease wastewater. The PUD also oversees a grant program for renewable energy resources. The Grease to Gas project qualified for a grant and the PUD prepared a report for the Utilities Board for approval of \$16,237 to cover the costs of laboratory services and analyses and equipment purchases and installation. The grant was approved on June 29, 2005. The total costs to date for labor, laboratory analyses, and equipment is approximately \$85,000.

The company agreed to charge City restaurants \$0.10/gallon to pump the grease interceptors (underground tanks connected to the restaurant wastewater drains). Other vacuum companies were charging \$0.15 to \$0.20/gallon to pump the interceptors. The contracted company also brings grease wastewater from other areas throughout southern California, from Santa Barbara to San Diego and from Los Angeles to Blythe. The City charges the company \$0.01/gallon (\$0.03/gallon in 2007) to receive the wastewater for disposal and receives about \$6,500/month in disposal fees. The project currently receives about 30,000 gallons per day of grease wastewater from restaurants in the southern California and, since March 27, 2006 has processed 6,800,000 gallons of grease wastewater.

The additional amount of methane gas generated by the addition of the grease wastewater has been as high as 493,000 cubic feet. This is the same as 4,930 therms of natural gas (100 therms per cubit foot). This is enough gas generated in one day to supply the winter needs of 101 homes in Riverside and the summer needs of 340. In one month, the gas generated at the treatment plant can be as high as 17,898,961 cubic feet or 178,989 therms. This is enough gas to supply the winter needs of 3,674 homes in Riverside and the summer needs of 13,055 homes in Riverside. The daily electrical generation of 1.5 megawatt-hours is enough electrical power to supply the needs of 1,128 homes in Riverside.

The effects on the sewer system were equally favorable. The sanitary sewer overflows (SSOs) caused by restaurant grease blockages were reduced from 30% of all calls to less than 1%.

An additional benefit of the project was the observed reduction in the amount of biosolids created from the treatment process. Since the introduction of grease wastewater into the digester, the number of methane forming bacteria has increased dramatically. These bacteria are also better adapted to metabolize solid organic material in the digester. As a result of the increased bacterial population, the overall biosolids production has been reduced by about 25%. This has reduced the average monthly wet tons produced from 5,000 to about 4,000. The disposal fee is \$48/ton and a reduction of 1,000 tons per month saves \$48,000/month.

One goal of this project is to achieve energy independence from natural gas. The project has reduced the natural gas requirements of the cogeneration power plant by 80%. This yielded a monthly savings ranging from \$80,000 to \$85,000 per month. The energy costs savings, reduced costs for biosolids disposal, and wastewater treatment charges created by this project have saved the City over \$1,000,000 in nine months.

8.23 Federal Stimulus Program Project Summaries